The figured worlds of high school science teachers: uncovering three-dimensional assessment decisions

Megan Ewald

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ABSTRACT

THE FIGURED WORLDS OF HIGH SCHOOL SCIENCE TEACHERS:
UNCOVERING THREE-DIMENSIONAL ASSESSMENT DECISIONS

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As a result of recent mandates of the Next Generation Science Standards, assessments are a “system of meaning” amidst a paradigm shift toward three-dimensional assessments. This study is motivated by two research questions: 1) how do high school science teachers describe their processes of decision making in the development and use of three-dimensional assessments and 2) how do high school science teachers negotiate their identities as assessors in designing three-dimensional assessments. An important factor in teachers’ assessment decision making is how they identify themselves as assessors. Therefore, this study investigated the teachers’ roles as assessors through the Sociocultural Identity Theory. The most important contribution from this study is the emergent teacher assessment sub-identities: the modifier-recycler, the feeler-finder, and the creator.

Using a qualitative phenomenological research design, focus groups, three-series interviews, think-alouds, and document analysis were utilized in this study. These qualitative methods were chosen to elicit rich conversations among teachers, make meaning of the teachers’ experiences through in-depth interviews, amplify the thought processes of individual teachers while making assessment decisions, and analyze assessment documents in relation to teachers’ perspective
The findings from this study suggest that--of the 19 participants-- only two teachers could consistently be identified as creators and aligned their assessment practices with NGSS. However, assessment sub-identities are not static and teachers may negotiate their identities from one moment to the next within socially constructed realms of interpretation known as figured worlds. Because teachers are positioned in less powerful figured worlds within the dominant discourse of standardization, this study raises awareness as to how the external pressures from more powerful figured worlds socially construct teachers’ identities as assessors. For teachers to re-author their scripts as assessors and create three-dimensional assessments, they first need to be aware of their assessment identity. Furthermore, the findings provide support for teachers to advocate for the development and use of assessments that measure students’ three-dimensional learning rather than relying on
THE FIGURED WORLDS OF HIGH SCHOOL SCIENCE TEACHERS: UNCOVERING THREE-DIMENSIONAL ASSESSMENT DECISIONS

BY

MEGAN EWALD
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF EDUCATION

DEPARTMENT OF CURRICULUM AND INSTRUCTION

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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>vii</td>
</tr>
<tr>
<td>CHAPTER 1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Problem and Purpose Statements</td>
<td>3</td>
</tr>
<tr>
<td>Research Questions</td>
<td>4</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>4</td>
</tr>
<tr>
<td>Significance Statement</td>
<td>7</td>
</tr>
<tr>
<td>Brief Introduction of Definitions</td>
<td>8</td>
</tr>
<tr>
<td>Methodology</td>
<td>10</td>
</tr>
<tr>
<td>Delimitations</td>
<td>10</td>
</tr>
<tr>
<td>Organization of the Dissertation</td>
<td>11</td>
</tr>
<tr>
<td>CHAPTER 2. REVIEW OF THE LITERATURE</td>
<td>12</td>
</tr>
<tr>
<td>The Next Generation Science Standards and Teachers’ Assessment Decision Making</td>
<td>14</td>
</tr>
<tr>
<td>Defining Assessment</td>
<td>16</td>
</tr>
<tr>
<td>Inconsistencies of Teachers’ Assessment Decisions</td>
<td>18</td>
</tr>
<tr>
<td>Teachers’ Knowledge and Development of Assessment Literacy</td>
<td>21</td>
</tr>
<tr>
<td>Teachers’ Philosophies and Beliefs about Assessment</td>
<td>24</td>
</tr>
<tr>
<td>Conceptual Framework: Historical Roots and Explanation of Sociocultural Identity Theory</td>
<td>26</td>
</tr>
<tr>
<td>Sociocultural Identity Theory Applied to Teachers’ Decision Making about Assessment</td>
<td>28</td>
</tr>
<tr>
<td>Figured Worlds</td>
<td>28</td>
</tr>
<tr>
<td>Positionality</td>
<td>30</td>
</tr>
<tr>
<td>Space of Authoring</td>
<td>33</td>
</tr>
<tr>
<td>Making Worlds</td>
<td>36</td>
</tr>
<tr>
<td>Teacher Assessment Identity</td>
<td>38</td>
</tr>
</tbody>
</table>
Tensions with Cross-cutting Concepts: “We’re almost 3D, we’re like 2.5D” .......................... 87
Teachers Negotiate Their Identity as Assessors Through Their Actions ........................................ 91
Use of NGSS Language: “I’m like the guy who didn’t read the story” ........................................ 91
Openness to Change: “That’s the hardest thing, being open to change” .................................. 95
Teachers Negotiate Their Identity as Assessors Through Collaborative Relationships ............ 100
Teachers’ Roles in Teams: “I feel like we all do have our own little roles” ................................. 100
Colleague Support: “NGSS guy” .................................................................................................. 105
Conclusion .................................................................................................................................. 108

CHAPTER 5. DISCUSSION OF FINDINGS AND CONCLUSION .............................................. 110

Summary of Findings: Four Key Assertions .................................................................................. 111
Discussion of Findings: Three Emergent Teacher Sub-Identities ................................................. 113
Teacher Assessment Sub-Identities .............................................................................................. 114
Sub-Identity #1: The Modifier-Recycler ....................................................................................... 115
Sub-Identity #2: The Feeler-Finder ............................................................................................. 120
Sub-Identity #3: The Creator ....................................................................................................... 125
Reconsideration of the Framework ............................................................................................... 127
Other Implications and Recommendations ................................................................................. 129
High School Science Teachers ................................................................................................... 129
Instructional Coaches ................................................................................................................ 132
Teacher Education .................................................................................................................... 133
District Administration ............................................................................................................... 134
Policymakers ............................................................................................................................ 136
Researchers ............................................................................................................................... 137
Conclusion .................................................................................................................................. 139
REFERENCES ............................................................................................................................. 140
APPENDICES .............................................................................................................................. 148
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High School Science Teacher Participants</td>
<td>48</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nesting visual of Sociocultural Identity Theory</td>
<td>6</td>
</tr>
<tr>
<td>2. A visual representation of refinement of Sociocultural Identity Theory</td>
<td>128</td>
</tr>
</tbody>
</table>
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. DISSERTATION STUDY CONSENT FORMS</td>
<td>149</td>
</tr>
<tr>
<td>B. FOCUS GROUP DETAILED INFORMATION</td>
<td>152</td>
</tr>
<tr>
<td>C. FOCUS GROUP PROTOCOL</td>
<td>154</td>
</tr>
<tr>
<td>D. PILOT STUDY CONSENT FORMS</td>
<td>156</td>
</tr>
<tr>
<td>E. INTERVIEW PROTOCOL</td>
<td>159</td>
</tr>
<tr>
<td>F. INTERVIEW AND THINK-ALOUD DETAILED INFORMATION</td>
<td>162</td>
</tr>
<tr>
<td>G. THINK-ALOUD PROTOCOL</td>
<td>164</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION

Not everything that can be counted counts, and not everything that counts can be counted.
-William Bruce Cameron (1963)

In an era of accountability, standardized tests, and discourse concerning “failing” schools, it is difficult to think about schooling without thinking about what can be measured or “counted.” Cameron (1963) made it clear, sometimes things of most worth cannot be quantified, and those of no importance can be easily measured. In the context of education, teachers are constantly making assessment decisions. Teachers decide on standards, concepts, and performance skills to be assessed. Although teachers spend a great deal of time assessing state standards, “measurable outcomes may be the least significant results of learning” (McNeil, 1986, p. xvii). Results from tests or exams do not speak to other immeasurable experiences students engage in or accurately measure student growth in other areas besides academic achievement. According to Kohn (2011), “It takes courage to do right by kids in an era when the quantitative matters more than the qualitative, when meeting (someone else’s) standards counts more than exploring ideas, and when the ‘rigorous’ is automatically assumed to be valuable” (p. 33). We live in a society where points, ratings, and scores matter often more to students than learning.

In the field of science, it was not until the adoption of Next Generation Science Standards (NGSS) in 2014 that the Illinois Standards of 1997 and assessments were changed from traditional, multiple choice, and short answer to include performance tasks that assess three-dimensional learning. In May of 2016, the new computer-based large-scale assessment in
Illinois, Illinois Science Assessment (ISA), was developed to assess NGSS. In the fall of the 2016-2017 school year, NGSS was fully implemented (NGSS Lead States, 2013). The purpose of the new assessment structure, as discussed in the assessment framework (CCSSO, 2015), is to assess students’ knowledge base across three dimensions: Science and Engineering Practices (SEPs), Cross-Cutting Concepts (CCCs), and Disciplinary Core Ideas (DCIs), within a phenomenon-based context (NGSS Network, 2015). The blending of SEPs, CCCs, and DCIs are the three pillars of three-dimensional learning. Therefore, high school science teachers need to develop three-dimensional assessments that assess students’ performance in constructing explanations and reasons for content specific to real life phenomena.

The evolution of educational reforms and science standards has shifted assessment practices of high school science teachers to create items that assess conceptual understanding, incorporating real-world problem solving skills aligned to recommendations made by NGSS (Sandlin, Harshman, & Yezierski, 2015). Even though there is a strong push to implement NGSS and change classroom assessment practices, ultimately it is up to the high school science teachers’ perceptions of coherence (Penuel & Fishman, 2012) and their interpretations of standards to shape their classroom practices (Spillane, Reiser, & Gomez, 2006).

NGSS restores some autonomy for high school science teachers to design curriculum around phenomena and construct storylines, or conceptual context, to assess students’ proficiency around clusters of performance expectations (NRC, 2014). Although more resources have been developed for teachers to support curriculum development (Krajcik, Codere, Dahsah, Bayer, & Mun, 2014), teachers may handle the recommended assessment framework differently and make decisions suitable for their students and community. High school science teachers have
control over the assessments in the classroom as to whether they are aligned highly, moderately, or very little to NGSS recommendations (Kawasaki, 2015).

Problem and Purpose Statements

In the wake of adopting NGSS, high school science teachers are called to develop classroom assessments that include “performance-based” items which “require students to construct or supply an answer, produce a product, or perform an activity” (NRC, 2014, p. 24). In addition to adopting new science standards, the adoption of ISA reflects the paradigm shift in science education to educate scientifically literate citizens who not only “know” science but can “do” science.

Although the new standards are mandated by the state, “Educational change depends on what teachers do and think- it is as simple and complex as this” (Fullan, 2001, p.117).

Ultimately, change in assessment practices is dependent on teachers’ own sense of agency. There are a few empirical studies that address how teachers understand and enact assessments using NGSS as a framework (Daghan & Akkoyunlu, 2014; Izci & Siegel, 2015; Kloser, 2014; Sandlin et al., 2015). However, understanding how teachers re-orient themselves and socially construct their changing identities as assessors may help teachers to better align with NGSS (Kawasaki, 2015).

Therefore, more research needs to be conducted that addresses how teachers orient themselves or negotiate their identities as assessors through collaboration and the decision-making process of developing assessments aligned to NGSS. Thus, the purpose of this study is to examine high school science teachers’ perspectives on their decision making in developing three-dimensional assessments aligned to NGSS, through a Sociocultural Identity Theory lens.
Research Questions

In this study, the following research questions are addressed:

1. How do high school science teachers describe their processes of decision making in the development and use of three-dimensional assessments?

2. How do high school science teachers negotiate their identities as assessors, individually and collaboratively, in designing three-dimensional assessments?

Theoretical Framework

This study is framed around Sociocultural Identity Theory (Holland, Lachicotte, Skinner, & Cain, 1998). This framework provides opportunities to better understand how teachers’ assessment identities inform their decision making and how their decisions in turn construct their identities as assessors. According to Holland et al., identity formation occurs through four contexts: figured worlds, spaces of authoring, positionality, and making worlds.

Figured worlds are socially constructed processes, activities, communities, traditions, or groups that are continually shaped, reformed, and ranked among other figured worlds. For example, high school science teachers participate in collaboration teams, course teams, committees, professional development, and other various groups within the larger figured world of teaching in making assessment decisions. Mediating devices such as artifacts or tools provide “systems of meaning” within figured worlds (Holland et al., 1998). In relation to this study, teachers’ assessment decisions regarding the incorporation of three-dimensional assessments act as artifacts within the figured world of teaching. Recognizing the external pressures placed on teachers from other more powerful figured worlds including policymakers, educational administrators, the public, parents, and large-scale assessment developers (Thomas, 2005),
Sociocultural Identity Theory provides insight on how teachers constantly balance their beliefs with the realities of the classroom and societal pressures when making assessment decisions. Thus, high school science teachers may “self-author” their assessment identities through improvisation or spontaneity of their assessment decisions within their collaboration or course team. Collaboration or course teams provide spaces of authoring for new assessment identities.

However, in regard to positionality, teachers can change their identities as assessors by repositioning themselves or being positioned by others to imagine, prepare, and enact new roles. Through positioning in the figured worlds of teaching, teachers may accept, reject, or negotiate identities offered (Adie, 2013) and construct their identities through discourse and use of assessment practices. For example, high school science teachers tasked with designing assessments that assess three-dimensional learning will position themselves or be positioned by others to accept, reject, or negotiate a new identity as an assessor. Because assessment decisions are socially constructed, systems of meaning, understanding how high school science teachers negotiate across and make new figured worlds, are positioned in figured worlds, have little access to, or are not included at all in particular figured worlds will help to inform the decision making process of teachers.

Figure 1 is a representation of the framework constructed from the definition of identity used by Holland et al. (1998) and the concept of culture as “lived” beliefs (Gutierrez & Rogoff, 2003) or customs shared between teachers and the school community within a larger societal construct. Teachers’ identities as assessors continuously evolve based on past and current experiences, as well as collaborative professional relationships. These experiences and relationships are influenced by individual cultures and the viable culture of the school. The larger society encapsulates these factors along with historical perspectives. Therefore, teachers’
assessment identities play a role in their assessment decision making. The teachers’ assessment identity relies on their own sense of agency, or capacity, to act freely in making assessment decisions within a figured world susceptible to the more powerful structures of standardization. The development or use of three-dimensional assessment practices conversely shapes the identities of teachers as assessors. Further examination of Sociocultural Identity Theory as the theoretical framework for this study is presented in Chapter Two.

Figure 1: A nesting visual representation of Holland’s et al. (1998) Sociocultural Theory of Identity in relation to the research study. Society, school culture, experiences, collaborative relationships, and sense of agency in making assessment decisions constructs a teacher’s identity as an assessor. The double arrow represents how teacher identity may influence their sense of agency and, in turn, teacher their sense of agency may influence teacher identity.
Significance Statement

There is a lack of research regarding how high school science teachers make three-dimensional assessment decisions. This study is important because it will add research focused specifically on high school science teachers’ reasons in developing their day-to-day assessments, both independently and collaboratively. Ultimately, high school science assessment decisions are dependent on the classroom teacher, so there needs to be more research exploring assessment decision making through the voices of high school science teachers.

The findings of this study may be used to improve high school science teachers’ assessment practices aligned to NGSS by providing insight as to how teachers make assessment decisions. It may also help to amplify the voices of high school science teachers in gathering research on how to modify or change science teacher education and professional development on assessment practices specific to the discipline of science. The results from this study may inform administrators in finding ways to provide high school science teachers professional development that directly addresses science assessment practices. Additionally, the findings may provide more information on how teacher collaboration and identity formation influences teachers’ assessment decisions within the dominant discourse of standardization. Ultimately, by examining how high science teachers in a specific district make their assessment decisions through a Sociocultural Identity Theory lens, others may learn components that influence science teachers’ assessment decision making.
Brief Introduction of Definitions

To provide clarity, the terms to be defined in this section include: agency, classroom assessment, crosscutting concepts, decision making, disciplinary core ideas, formative assessment, performance-based assessment items, performance-based assessment methods, science and engineering practices, and summative assessment. Many of the key concepts will be defined more fully in the next chapter.

**Agency:** The capacity of a teacher to exert power and have a sense of ownership, or control, over the assessments given in their classroom (Holland et al., 1998).

**Classroom Assessment:** The process of collecting evidence of student learning. Because assessment includes more than paper-pencil “tests,” classroom assessment can be divided further into *summative* and *formative* assessment (McMillan, 2007).

**Crosscutting Concepts (CCCs):** As stated in the NGSS (NGSS Lead States, 2013), assessments should require students to apply content across different concepts. The concepts include: patterns, cause and effect, scale, systems, energy and matter, structure and function, and stability and change.

**Decision Making:** Identified as a basic teaching skill (Shavelson, 1973), teachers make constant choices with regards to beliefs about assessment (Wilen, Ishler, Hutchison, & Kindsvatter, 2000). For example, in the context of this study, a high school science teacher who aligns with NGSS may choose to gather evidence of student learning by asking the students to create and draw a model of a concept, and then explain it with a partner.

**Disciplinary Core Ideas (DCIs):** As stated in the NGSS (NGSS Lead States, 2013), assessments should require students to apply content knowledge in the physical sciences, life sciences, and earth sciences.
**Formative Assessment**: Using a variety of strategies and tools, gathering evidence of student’s knowledge during the learning process, to inform educators on where to go next and the student to improve learning (Stiggins, 2002). For example, formative assessments include exit slips, class discussions, lab conclusions, or progress quizzes.

**Performance-based assessment items**: Requiring students to perform hands-on tasks including the creation of artifacts or the development of models to answer complex real-life application questions related to the science content (NRC, 2014). For example, a performance based assessment item in chemistry would require students to design a model that explains how the brain perceives different smells from different shaped molecules.

**Performance-Based Assessment Methods (PBAMs)**: Teacher designed techniques to measure student learning through real-life application in a classroom setting. Techniques include tasks, projects, labs, demonstrations, and portfolios that require students to classify, compare, analyze, or evaluate content (Palm, 2008). The student products are measured by their ability to apply skills and knowledge using higher order thinking (Chun, 2010).

**Science and Engineering Practices (SEPs)**: As stated in the NGSS (NGSS Lead States, 2013), assessments should require students to apply content knowledge by: asking questions and defining problems, developing models, planning and carrying out labs, analyzing data, using mathematical thinking, constructing explanations and designing solutions, engaging in arguments from evidence, and obtaining, evaluating, and communicating information.

**Summative Assessment**: Usually completed at the end of a unit, summative assessment provides evidence for educators to make judgments of student achievement that is reported and communicated to students, parents, and the educational system (Stiggins, 2002). For example, summative assessments include unit tests, final projects, or final exams.
**Three-dimensional Assessment**: Formative or summative classroom assessments that contain multiple components including: Science and Engineering Practices (SEPs), Cross-cutting Concepts (CCCs), and Disciplinary Core Ideas (DCIs) (NRC, 2014).

**Methodology**

A phenomenological research study approach was used to examine high school science teachers’ perceptions of their reasons in making assessment decisions. The 19 participants from one high school science department, in a community outside a large Midwest City, were identified through criterion sampling. All 19 participants participated in one focus group. Next, eight teachers were identified, based on their responses in the focus group, to be interviewed and to participate in a think-aloud. Documents, such as assessments, assessment tools, and planning tools were collected from the teachers interviewed. Furthermore, data collected through focus groups, interviews, and documents were analyzed using two cycles of coding, “Emotion Coding” and “Theming the Data,” then “Focused Coding” to create “categories of categories” (Saldaña, 2013). Finally, key findings were memoed and supported through peer review in order to include the strongest assertions in Chapter 4.

**Delimitations**

This study was limited to science teachers from one high school district in the Northwest suburbs of Chicago. Furthermore, to allow for an in-depth analysis of the data collected from multiple focus groups and interviews, the sample of teachers studied was kept to a small manageable number.
Organization of the Dissertation

This study is organized into five chapters. The next chapter contains a review of the literature in the areas of (a) historical perspective and inconsistencies of assessment, (b) teachers’ knowledge and beliefs about assessment, (c) elements that contribute to teachers’ assessment decisions, and (d) an in depth review of the theoretical framework, Sociocultural Identity Theory. The third chapter focuses on the methods used to complete the study. The fourth chapter provides analysis of four key assertions that emerged from the data. Finally, the fifth chapter includes a discussion of the findings and provides implications and recommendations for future research.
CHAPTER 2

REVIEW OF THE LITERATURE

In response to NGSS and ISA, science curriculum in Illinois has already been or will be re-designed to address the three dimensions of NGSS. The State of Illinois Board of Education fully adopted NGSS in 2014 as the Illinois State Standards. As stated in a report (NRC, 2006) prior to the framework (NRC, 2012), a coherent system of science assessments that combines multiple approaches (large-scale and classroom assessments) to effectively assess student learning should be in place. In this coherent system, “...assessment must be considered a part of the overall system of science education” (NRC, 2014, p.43).

The new Next Generation Standards and assessment framework are a paradigm shift from the old paradigm of science education and the 1997 Illinois Science Standards. According to Kuhn (1962) the term paradigm means a model or framework made up of related beliefs, values, procedures, principles, and assumptions. A paradigm shift occurs when new discoveries can render models obsolete. Although Kuhn used the term paradigm shift to explain scientific revolutions, a paradigm shift could also be used to describe a change in a fundamental model. In the context of science education, the adoption of NGSS has shifted science classroom instruction from teacher-centered to student-driven inquiry experiences, often designed by students, which are focused around skills and “doing” science practices. This change in instruction has also shifted the expectations for science classroom assessments to be performance-based and three-dimensional rather than simply assessing content knowledge.
Classroom assessments need to be aligned to the new standards that engage students in three-dimensional learning; therefore, according to the NRC (2014) “three-dimensional learning described in the framework and NGSS cannot be well assessed without some use of the more extended engagements that are really only possible in a classroom environment” (p. 198). Thus, in a “systems approach,” assessments are designed to (a) support day-to-day classroom instruction, (b) monitor scientific literacy, and (c) monitor that students are provided experiences to learn science as recommended by the framework and NGSS (NRC, 2014).

For example, in day-to-day instruction, high school science teachers would assess students as they taught a new concept or skill in order to guide the next days’ instruction. Depending on the science teacher, this form of assessment may be varied. To monitor scientific literacy, state and local policymakers would provide standardized, external science assessments designed around the NGSS performance expectations. Finally, to monitor that students are provided experiences to learn science as recommended by NGSS, states would have to collect data. This data includes: observations of science programs, student and teacher surveys, evaluations from professional development programs, curriculum documents, and student artifacts (NRC).

Utilizing a “systems approach” (NRC, 2006), teachers will need to integrate assessments into instruction and interpret the results to guide future teaching decisions. The NRC (2014) stated:

Because NGSS-aligned instruction will naturally involve a range of activities, classroom assessment that is integral to instruction will need to involve a corresponding variation in the types of evidence it provides about student learning. Indeed, the distinction between instructional activities and assessment activities may be blurred, particularly when the assessment purpose is formative. A classroom assessment may be based on a classroom discussion or a group activity in which students explore and respond to each other’s ideas and learn as they go through the process. (NRC, 2014, p. 87-88)
Teachers can only gather evidence of student learning when they construct classroom experiences and activities that engage students to use the three-dimensional standards. In order for students to learn engineering practices they will need to have the opportunity to demonstrate the use of those practices in the context of disciplinary core ideas. For example, students need to be able to identify patterns before they can interpret data. The classroom instruction then becomes the medium by which teachers can assess if students are learning the standards.

The Next Generation Science Standards and Teachers’ Assessment Decision Making

In the findings from Kawasaki’s study (2015), teachers were identified by how well their assessment identities aligned to NGSS. Similar to groupings from past identity research studies (Bower, 2012; Freedman & Appleman, 2008; Sloan, 2006), the three identity groups that emerged were high, moderate, or very little alignment. Teachers with high alignment to NGSS relinquish control within their classroom, allowing students to take more responsibility in directing their assessments and learning experiences. Teachers who moderately aligned to NGSS felt tensions between incorporating science and engineering practices (SEPs) and still being held accountable for student learning. Although NGSS views practices and student learning as complementary, the teachers in the study did not always engage in assessment practices to meet the demands of NGSS but would at times fall back on more traditional forms of assessment. Teachers who expressed low alignment did not align with NGSS nor use any of the Science and Engineering Practices in designing assessments. Research findings from Kawasaki (2015) and other empirical studies (Daghan & Akkoyunlu, 2014; Izci & Siegel, 2015) may help to inform the analysis of teachers’ assessment decisions using NGSS in relation to their identity.
An empirical study by Daghan and Akkoyunlu (2014) examined the reasons why teachers may not effectively use Performance-Based Assessments Methods (PBAMs) (ie: portfolios, projects, tasks) in the classroom setting. Although lack of time to fully implement PBAMs was considered to be a deterring factor, the main reason for not using PBAMs effectively was because teachers did not fully internalize the evaluation philosophy stipulated by the curriculum. The teachers in this study resisted or did not align to the assessment framework. Even teachers who had a positive attitude towards PBAMs did not necessarily follow along because they struggled to give up conventional habits and could not internalize assessments with a performance task approach. The teachers moderately followed the curriculum or negotiated the approach to align with their own educational philosophies. Teachers in this study who fully executed PBAMs in the classroom did so because they internalized the paradigm shifts brought about by the assessment approach. The teachers who accepted and aligned to the assessment framework evaluated the whole performance process and provided an environment where students took responsibility for their learning. The findings from this study reinforce how teachers may reject, negotiate, or accept alignment to specific assessment frameworks due to their internalization of the framework in relation to their own identity as an assessor.

Izci and Siegal (2015) studied a high school chemistry teacher to explore her assessment struggles aligning to the NGSS assessment framework. Although the teacher voiced the value of constructing assessments that support conceptual learning by “doing” science, she did not select or use appropriate tasks to accomplish her aim. Izci and Siegal stated multiple reasons for not using appropriate assessment methods including lack of: 1) time and materials, 2) content knowledge, 3) teaching experience, and 4) colleague support. The authors suggested that
teachers need to observe and experience successful assessment practices in order to implement them in their own classrooms.

Defining Assessment

Assessment is a hefty term that carries with it multiple purposes and meanings. The term assessment is derived from the latin words *ad + sedere* meaning “to sit beside” (Loacker, Cromwell, & O’Brien, 1986). According to Ewell (2002), assessment can be a tool in determining an individual’s mastery through observations and continuous feedback, a large-scale assessment used to examine district performance, or can serve as a tool to improve pedagogy or curriculum. Ewell suggests there is a dichotomy of assessment: assessment for accountability and assessment for improvement of student learning. Assessments developed for accountability do not necessarily resemble assessments used to improve learning. There are a variety of assessments and a polarity of purpose.

Although assessment is often used synonymously with the term test, not all assessments are paper-pencil tests. A test is a collection containing numerous samples of observations of a behavior or content knowledge (Cizek, 2001). A single test score may provide enough information about a student to make educational decisions regarding placement or ability level. Therefore, good decisions can be made on the basis of a single test score considering that even poorer decisions are made using information from a lesser caliber (Cizek, 1994).

Popham (2009) classified the term assessment into two parts: accountability assessment and classroom assessment. Standardized tests and measurement devices used by the government or school district to measure effectiveness of a school in its educational attempts would be considered accountability assessment. The evidence collected provides a snapshot of content
retention and skill development. Good or bad, these tests provide data about students that otherwise would not be able to be seen or conceptualized. Stiggins (2002) refers to accountability assessment as “an index of the success of our efforts. It is testimony to our societal belief in the power of standardized tests that we would permit so many levels of testing to remain in place, all at the same time and at very high cost” (p.3). Results from these assessments are valued in our society and are used to make school improvement decisions.

Utilizing either formal or informal procedures, teachers can make inferences about what students know. Because assessment includes more than paper-pencil “tests”, classroom assessment can be divided further into summative and formative assessment (McMillan, 2007). Differences between summative and formative assessments are due to purpose and effect (Sadler, 1989).

Stiggins (2002) refers to summative assessment as assessment of learning which would include assessments completed at the end of a unit. Summative assessments provide evidence for educators to make judgments of student achievement that is reported and communicated to students, parents, and the educational system. The outcomes of summative assessment can be used to make changes in curriculum, plan future goals, and provide necessary information to promote students onto the next grade level.

Stiggins (2002) defined formative assessment as assessment for learning. Formative assessment involves the students and is done concurrently within the learning process. Using a variety of teaching strategies and assessment tools, formative assessment gathers evidence of students’ knowledge during the learning process. This data helps to inform the educator on where to go next or what concepts need to be retaught. Formative assessment also informs the students of their current level of understanding so they may reflect and make changes to improve
Formative assessment, according to Black and Wiliam (1998), are “all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (p. 10). Therefore, formative assessment may not be reported as a grade but is used purely as feedback for learning. Formative and summative assessments are important pieces of learning for both the students and the teachers involved.

Although it has been mentioned that both formative and summative assessment play an important role in student learning (Sadler, 1998), teachers struggle with adhering to a clear focus and purpose of formative assessment (Andrade & Cizek, 2010). Specifically, formative assessment is effective due to its non-evaluative nature. The focus of formative assessment is to have timely and specific feedback that engages the student in the learning experience. This rich experience is hindered if the assessment is a graded quiz or assignment (Andrade & Cizek, 2010). Even with empirical evidence for formative assessment (Black & Wiliam, 1998; Sadler, 1989, 1998) that focuses on assessment for learning through “trial and error” (Sadler, 1989), teachers feel the need to report a grade thereby turning it into summative assessment (Geoghegan, 2014).

Inconsistencies of Teachers’ Assessment Decisions

Many inconsistencies when it comes to teachers’ assessment decisions stem from multiple purposes of assessment (Bell & Cowie, 2001). One purpose of assessment is for standardization. For example, the figured world of policymakers uses assessment as a tool for accountability. The standardized assessments are used to drive changes in practice and policy by holding districts accountable to reform (Bell & Cowie). According to the National Research
Council (1999), the purpose of accountability assessment is to attach incentives to high performance on state and local assessments. The figured world of school districts highly rely on the outcomes from these accountability assessments since it serves as a measure of their effectiveness compared to other nearby districts.

The desire to measure effectiveness leads to the second purpose of assessment which is to monitor student progress or improvement (Bell & Cowie, 2001). The figured worlds of policymakers, district employees, and community members look to assessment data to know how much the students are learning compared to other standards or their peers. Even more so, this data provides information to the parents, students, and educators on how well the students are learning the course objectives or performance standards.

The Illinois Performance Reform Act (PERA) of 2010 (Public Act 96-861), modified by the Senate Bill 7, requires all schools in Illinois to incorporate student growth measures as an evaluative tool by using pre-and post-test classroom assessment results to determine teachers’ proficiency rating. Therefore, in the figured world of teaching, teachers may feel more pressure to modify assessment practices since student growth is now a component of their evaluation tool. For example, in a study by McMillan, Myran, and Workman (2002), where 28 teachers from different levels were interviewed, tensions between two sources of influences on teachers assessment decisions emerged: teacher beliefs and how the assessment outcomes are utilized. Specifically, teachers were concerned how the assessment outcomes were viewed by parents, the district, and future employers. Also, teachers felt pressure to modify assessment to improve standardized test data. Thus, the incorporation of student growth measures in teacher evaluations may have a similar effect and lead to inconsistencies in teachers’ assessment practices.
The third purpose of assessment practices is to provide teachers and students with feedback (Bell & Cowie, 2001). Students can utilize the feedback to self assess and alter their learning strategies to improve their learning; and teachers can use the feedback to revise their instructional strategies to improve student learning. However, there may be inconsistencies in the information that the feedback provides to teachers and students. For example, Crisp (2013) examined teacher judgment processes when evaluating student work against an assessment rubric or tool. The rubrics provided assessment criteria as a guide for making final summative assessment decisions. The findings from this study indicated rubrics may be used differently among educators. Two factors influencing rubric assessment judgments were teacher comparisons with other educators and teacher experience with assessment tools. The study suggested teachers within one school environment follow a certain set of assessment guidelines; however, teachers’ interpretations of assessment criteria may be inadvertently different.

Along with inconsistencies in teachers’ interpretations of student feedback, teachers’ also experience inconsistencies as to the type of feedback the assessment provides. For example, Svennberg, Meckback, and Redelius (2014) interviewed teachers to explore which criteria were more important to include in summative assessments. Four themes emerged from the research data. Student motivation, knowledge and skills, self-confidence, and interactions with others were the major pieces of criteria teachers considered in summative assessment decisions. The teachers struggled predicting which criteria had relevance to final assessment decisions, and sometimes “important” criteria, such as assessment of specific standards were not included.
Teachers’ Knowledge and Development of Assessment Literacy

Stiggins (1995) refers to teachers’ assessment knowledge as assessment literacy. To be considered assessment literate, teachers need to know the difference between “sound” and “unsound” assessment. Criteria for sound assessment includes: validity, reliability, practicality, and authenticity. Teachers need to know what they are assessing, why they are assessing it, and know how to best assess the specific knowledge or skills in question. Assessment literate teachers know what can go wrong and take precautions as to prevent problems ahead of time. The assessments produced by teachers with assessment literacy generate “good” examples of student performance.

Even with a clear definition of what it means to be assessment literate, academic research conducted twenty years later is still addressing the issue. Despite the efforts made by assessment experts and scholars, teachers continue to feel unprepared in their ability to assess student learning (DeLuca & Bellara, 2013). For example, in a study conducted by Mertler (2004), 67 pre-service and 101 in-service teachers were surveyed using the Classroom Assessment Literacy Inventory (CALI) to examine their assessment literacy. The in-service teachers scored highest in administering, scoring, and interpreting the results of assessments. These results seem reasonable since in-service teachers have more experience in carrying out assessment in the classroom. The pre-service teachers scored highest on choosing the appropriate assessment methods. As teachers move from pre-service to in-service, choices made regarding assessment practices move from theory to practice. It is clear from this study pre-service teachers are aware of what assessment methods should be used; however, factors within the reality of the school which they are working may prevent in-service teachers from using them. Overall, in-service teachers scored higher in the areas mentioned previously, but both groups scored low on developing valid assessment
procedures. Mertler states that assessment courses are not well aligned with what teachers need to know in daily classroom practice. Many of the assessment textbooks used by pre-service teachers emphasize standardized assessment and have few chapters on alternative classroom assessment. This study is important because it advocates assessment literacy not only for educators but for all stakeholders, including parents, students, district administrators, and policymakers.

One of the major findings in a mixed methods research study consisting of document review, survey data from 42 teachers, interviews with 8 teacher leaders, and focus groups to examine teachers’ perspectives on the topic of grading was that teachers have very little training in assessment practices (Webster, 2011). The little amount of training may affect teachers’ focus on attempting to try different alternative methods. If teachers have little training, then they are less likely to experiment with methods promoted by assessment experts or the NGSS.

Even with adequate training, it may still not be enough for a teacher to become an assessment expert. Grainger and Adie (2014) studied 96 pre-service teachers in a pilot project participating in ongoing assessment training. The teachers were surveyed and the results showed that additional opportunities were necessary for teachers to move from being novice to expert assessors. While the teachers valued the process of learning, discussing, and justifying assessment decisions with peers, the teachers struggled with coming to a consensus on the feedback provided to the students. Although the majority of pre-service teachers felt better prepared after going through the assessment training, many of the teachers still indicated a lack of assessment knowledge in the survey results. The assessment training alone was not transformative for all the teachers involved.
Reflection may be a key component in successful teacher assessment training. Mertler (2009) studied an intensive two-week teacher assessment workshop for in-service teachers. The seven teachers, who completed the program, were able to critically examine and reflect on their assessment practices through reflective journaling throughout the two week workshop. Upon analysis of the Assessment Literacy Inventory pre and post-test scores, the training seemed to be effective in increasing the teacher's assessment knowledge. More importantly, the teachers gained more insight through critical examination of their reflection journals. However, it is unknown how long lasting the effects were from the workshop, or if the intensive experience actually transformed the teacher's daily assessment practices.

According to the findings from Howley, Howley, Henning, Gilla and Weade (2013), teachers’ assessment knowledge often goes beyond what they initially predicted. Through interviews with teachers from three different high schools, they concluded that teachers are knowledgeable in multiple areas of assessment. These areas include constructing quizzes and tests, developing assessment tools or rubrics, understanding the limitations of standardized assessment, and having the ability to utilize multiple types of assessment to accommodate learner needs. The teachers in this study viewed their assessment knowledge as a part of their “professional repertoire” and took responsibility in their ongoing learning and professional development. They also worked collaboratively with other educators to learn and acquire new assessment knowledge. Assessment literacy does not only benefit students, but the long-term professional well-being of educators (Popham, 2009). In an environment where teachers are evaluated based on assessment data, it is imperative that teachers possess the knowledge necessary to accurately measure students’ learning.
Although research states teachers are knowledgeable of assessment (Howley et al., 2013), teachers are not always cognizant of their knowledge or are aware they are using formative assessment methods (Geoghegan, 2014). Critical reflection of teachers’ assessment methods in practice becomes beneficial. Professional development opportunities that provide experiences for teachers to engage in critical reflection and analysis of their assessment practices are rare but necessary (Geoghegan, 2014).

Teachers’ Philosophies and Beliefs about Assessment

Understanding that teacher assessment training may be lacking, Siegel and Wissehr (2011) studied 11 secondary education pre-service science teachers to closely examine their assessment literacy. In this study, the pre-service teachers’ assessment literacy was compared with the actual assessments used in lesson planning. One key finding from this study was in relation to how pre-service teachers viewed assessments theoretically compared to their actual practice. The teachers’ philosophies and reflections compared to daily assessment practices were drastically different. The assessments weaved throughout the inquiry based science units did not align with the teachers’ assessment philosophies. Although this study only focused on pre-service teachers, it may be relevant to teachers at any level of experience. Rather than utilizing alternative methods of assessment including equitable assessments, journaling, and discussion; the teachers relied more on traditional methods including worksheets and presentations.

Tensions between teachers’ summative assessment practices and personal beliefs of summative assessment were evident in a meta-analysis conducted by Moss (2013). Throughout the literature, there were clear discrepancies between teachers’ perceptions and self-reports of actual practices in use. Teachers were more likely to use objective tests rather than alternative
forms of assessment even though the tests used did not match their beliefs of effective assessment. It appeared the teachers had a lack of assessment knowledge. The teachers’ perceived knowledge of assessment had a greater influence than experience with alternative assessment methods. Evident in the conclusion by Moss, teachers were overconfident and under competent using assessment to improve student learning.

In order for teachers to discuss or eventually change their assessment practices, Mansour (2009) suggests teachers need to first identify their professional beliefs. Once teachers are aware of their professional assessment beliefs, they can recognize their control over assessment practices in use. Understanding contextual factors can be a barrier to practice; teachers need to take responsibility for changing practice and need the freedom to implement practices aligned to their beliefs. These beliefs should be uncovered early on in a teacher’s career. As Pajares (1992) states, “people grow comfortable with beliefs and they become their ‘self’ so that individuals come to be identified and understood by the very nature of beliefs and habits they own” (p.317). Teachers struggle implementing new practices that align with their philosophy or beliefs of assessment (Cox, 2011), since those beliefs become their ‘self.’

Duncan and Noonan (2007) examined assessment practices of 513 high school teachers. The study revealed teachers’ understanding of their assessment decisions and actual agency contributes to developing assessment principles. The process of aligning teacher beliefs to practices may ultimately improve instruction and student learning.

A study by Levin and He (2008) has shown that teachers bring with them personal practical theories that influence their practices. In this study, 472 self-reported personal practical theories were collected from 94 pre-service teachers to develop a model of beliefs they bring
with them to the field. Teacher educators are better able to influence pre-service teachers’ knowledge and practices when their current views and perspectives are uncovered.

Unfortunately, as stated by McMillan (2003), teachers find it difficult to give a rationale for their assessment decisions because they may not be aware or understand why they are making those decisions. According to Stenberg, Karlsson, Pitkaniemi, and Maaranen (2014), educators should be aware of teachers’ “starting point” or professional beliefs to provide meaningful professional development in shifting their traditional thinking. In the study, practical theories of 71 first-year student teachers were analyzed to determine what kinds of positions were involved in their teacher identity. It was concluded teacher “identities” not only affected their education but also shaped how they oriented themselves for future learning and teaching. Therefore, teacher identity should be a focus in teacher education.

Conceptual Framework: Historical Roots and Explanation of Sociocultural Identity Theory

Mead describes identity through a sociological and anthropological lens as a “procesual self,” continuously re-created in relation to an individual’s role and agency in society (Holland & Lachicotte, 2007). Mead’s concept of identity formation has some similarities to Vygotsky’s understanding of self as one that informs an individual’s interpretations and behaviors (Holland & Lachicotte, 2007). Vygotsky’s (1978) construct of semiotic mediation proposes that individuals develop “voluntary control over behavior - the hallmark of ‘higher mental functions’ - through this mediation by cultural devices” (Holland, Lachicotte, Skinner, & Cain, 1998, p. 35). Vygotsky, suggested that individuals construct and utilize symbols that society has “assigned meaning” and the symbols may inform individuals’ social positioning. Similar to Vygotsky’s notion of semiotic mediation, Bakhtin referred to identity as “the authoring self” where “persons
develop through and around the cultural forms by which they are identified, and identify themselves, in the context of their affiliation or disaffiliation with those associated with those forms and practices” (Holland et al., 1998, p. 33).

Based on Mead’s (1934) notion of identity formation, Vygotsky’s (1978) cultural historical work, and Bakhtin’s (1981) socio-historic concept of “the authoring self,” Holland, Lachicotte, Skinner, and Cain (1998) developed the sociocultural theory of identity. In summary:

Persons develop more or less conscious conceptions of themselves as actors in socially and culturally constructed worlds...these identities...permit these persons, through the kinds of semiotic mediation described by Vygotsky, at least a modicum of agency or control over their own behavior. (Holland et al., p. 40)

According to Sociocultural Identity Theory, individuals acquire and gain multiple contradictory identities through the participation in socially organized positions within “figured worlds” as social agents or products. Figured worlds and mediating devices are socially constructed “systems of meaning.”

The concept of figured worlds is one of four sites of identity formation suggested by Holland et al. (1998). The other three contexts include: “positionality,” “spaces of authoring,” and “making worlds.” Positionality refers to how people place themselves in social interactions or take stances relative to other people within figured worlds (Vagan, 2011). According to Holland et al., positionality is a separate component from figuration. Individuals, positioned in a figured world, are limited by the degrees of acceptance and negotiation of identities offered.

Space of authoring, influenced by Bakhtin, is the ability to construct identity through internal and external dialogue (Holland et. al). World making, influenced by Vygotsky’s concept of “serious play,” is when new “imaginaries” provide a space for individuals to develop “new social competencies in newly imagined communities” (Holland et al., p.272). When imaginary
communities become concrete, Holland et al. states identity formation circles back to the first context of figured worlds. To explain how Sociocultural Identity Theory may be applied to teachers’ assessment decision making, the four contexts will be examined separately in relation to teachers’ identity as assessors.

Sociocultural Identity Theory Applied to Teachers’ Decision Making about Assessment

**Figured Worlds**

The first context of identity formation, figured world, is defined as “socially produced, culturally constructed activities” (Holland, et al., 1998, pp. 40-41). According to Holland et al. (1998), figured worlds may be “formed and re-formed in relation to everyday activities and events that ordain happenings within it” (p. 53). A figured world is also defined by Holland et al. as a “constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (p. 52). In other words, a figured world can include processes or traditions that are socially constructed and happen in historical time (Holland et al.).

Although figured worlds are constantly being formed or re-shaped, not everyone may be granted access. Holland et al. (1998) states “some figured worlds we may never enter because of social position or rank; some we may deny to others; some we may simply miss by contingency; some we may learn fully” (p. 41). Teachers would fall into the figured world of teaching. According to Pennington (2007), who reviewed the No Child Left Behind Act of 2002 through the concept of figured worlds (Holland et al.), policy and teaching are considered to be two separate figured worlds. The two worlds are: defined hierarchically; rarely intersect; and are
shaped by power, status, and rank. Pennington, in reference to NCLB, stated that lawmakers have passed laws about education and assessment without input from teachers, and teachers cannot teach or assess without input from policymakers. Therefore, the figured world of teaching has been placed well below the figured world of policymakers (Pennington, 2007).

Teaching and policy are only two figured worlds in relation to educational decision making. Drawing attention to the role of power in figured worlds, Thomas (2005) listed the following figured worlds in descending order: politicians (policymakers), educational administrators, public and parents, test makers, teachers and students. In the figured world of policy, policymakers rely on standardized test scores as artifacts or tools to interpret children’s success (Pennington, 2007). In the case of NCLB, “test scores can be viewed as mediating artifacts” (Pennington, 2007). Ultimately, assessments are artifacts that can, and have been, used differently depending on the figured world.

Holland et al. (1998) explained the role of artifacts as “a kind of force by connection to their social and cultural contexts, to their figured worlds” (p. 63). In the figured world of policy, which according to Thomas (2005) has the most power or status in relation to the other figured worlds, assessment scores provide a narrow criteria for decisions that are made without consulting the figured world of teaching (Pennington, 2007). For example, policymakers interpret low-test scores as an indicator of failure to read; teachers interpret a low score as just one measure of a student’s ability to read one particular style of text (Pennington, 2004). According to Pennington (2007), “Teachers do want students to be successful on tests, but they also understand the limitations of tests and expect success beyond that of answering multiple-choice questions” (p. 470). Assessment is an artifact or tool utilized by both figured worlds of policy and teaching, but it is interpreted differently. The artifact overlaps both worlds, but
because teachers rank below policymakers they have less power. However, because assessment does overlap both worlds, teachers can use assessment to move across worlds to access power.

**Positionality**

Within the figured world of teaching, teachers can position themselves or be positioned. As mentioned earlier, positionality refers to how individuals are limited by varying degrees of accepting, rejecting, or negotiating identities offered to them within figured worlds. Holland et al. (1998) suggested that through the use of artifacts, individuals can move into more powerful positions within figured worlds. Artifacts include: objects, discourses, events, and people in figured worlds.

In a qualitative case study, Vetter (2012) studied positioning theory to better understand a first-grade teacher’s change process in a professional development figured world as she took on the role of teacher leader. The findings from the study suggested, not only did the teacher’s identity transform, but the members in the professional development group positioned her so she could imagine and prepare to take on the role of a leader in her school environment. Discourse with colleagues in the figured world of professional development provided a space for this teacher to imagine herself as a teacher leader, enact the role, maintain the role despite resistance, and then be seen as a leader in the figured world of teaching. The professional development group was a “safe place to try on new identities” (Vagan, 2011, p. 46). Outside of the group she could position herself as a teacher leader. By acting out the role and participating in dialogue to create a storyline for what it means to be a leader, the “group discussions became a vehicle for identity formation or for understanding life as a leader” (Vetter, p. 44). Although the teacher is
still within the figured world of teaching, she has been positioned by her colleagues in a new role as a leader.

The positioning of individuals through discourse in a figured world of professional learning was also examined by Vagan (2011), who studied medical students’ identities as they transformed in medical school. Holland et al. (1998) stated “Positional identities have to do with the day-to-day and on-the-ground relations of power, deference and entitlement, social affiliation and distance— with the social-interactional, social-relational structures of the lived world” (p.127). The medical students in the study, as described by Vagan, participated in a figured world, utilized artifacts formed by collective systems of meaning within the world, positioned and repositioned themselves in relation to others, depended on artifacts to “participate legitimately in training” (Vagan, p. 52), and identified themselves as characters in the figured world of medicine through the use of the specific artifacts. The students transformed their identities by acting out the role of “physician” in a figured world that encouraged such behavior and positioning.

Positioning through the possession or use of particular artifacts was studied through ethnographic fieldwork. Bartlett (2007) utilized Sociocultural Identity Theory to study Brazilian adult literacy students’ use of artifacts to “seem” or “feel” literate. The adults were able to “use cultural resources to contest social positioning” (p. 64) and assert themselves as literate. The artifacts or resources obtained by the students to “appear” literate included books, folders, and bookmarks. The artifacts mentioned were tools obtained by literate “actors” in the figured world. Upon analysis of field notes gathered from participant observation, shame was an emergent theme in the student’s ability to read, write, or communicate correctly. Similar to the previous study by Vagan (2011), discourse and communication were mediums through which social
activities took place and positioning occurred. Bartlett suggested the lack of communication between students in the figured world led some of the students to experience feelings of shame and of being disrespected. The students’ fear of being shamed or disrespected made the act of “doing literacy” risky. In this sense, respect and literacy became equivalent. Therefore, to maintain a level of respect the students obtained artifacts that made them “seem” or “feel” literate. The artifacts did not actually make the learners literate; however, the artifacts did make them feel literate because they challenged the socially prescribed identity put in place by the figured world.

In summary, studies have shown how activities, discourses, and possession of artifacts can challenge one’s position in figured worlds (Bartlett, 2007; Vagan, 2011; Vetter, 2012). Teachers’ professional identity, as seen through Sociocultural Identity Theory framework, is one in which multiple identities co-exist that are continuously shaped by experiences, discourses, and collaboration with colleagues in the figured world of teaching. Freedman and Appleman (2008) studied the development of teachers’ identities over a five-year period who were considered “at risk” of having high attrition due to teaching mostly underserved students. Utilizing the theories of Vygotsky (1978) and Bakhtin (1981) to explain how teachers’ form their identity through social positioning, three divergent teachers were studied: the “stayer” (teachers who stay in the profession), the “leaver but staying” (teachers who would like to leave but continue to teach), and the “leaver” (teachers who leave the profession). Through the lens of power and agency struggles within the figured world of teaching, it was determined that social interactions within the figured world constructed their identity. As their experiences changed so did their identities. According to Holland et al. (1998), identities are “lived” rather than static and teachers’ identities are continuously negotiated through social positioning in figured worlds.
In relation to teachers’ decision making about classroom assessment, the power and positioning of teachers as change agents rather than passive actors in figured worlds (Vetter, 2012) may provide a space for teachers to change their identity as “assessors” either individually or collectively (Vagan, 2011). Just as Bartlett (2007) recognized that students who experienced shame for being illiterate obtained socially constructed artifacts to seem or feel literate, teachers may make assessment decisions from socially constructed systems of meaning that reflect their professional identity within the figured world they live and collaborate.

**Space of Authoring**

Understanding that although teachers are positioned in figured worlds, teachers’ identity will be in constant flux due to the ongoing dialogue and activities in which they are involved. According to Holland et al. (1998), “Human agency comes through this art of improvisation; the space of authoring” (p. 272). In other words, “spaces can be opened and improvised by crafting new responses to circumstances or events” (Pennington, 2007, p. 471) allowing teachers the opportunity to re-author or change their “scripts”. Holland et al. is clear that authorship is not a choice; however, people are offered positions that can be accepted, rejected, or negotiated through their own sense of agency and dialogue. Similarly, studies have shown that teachers’ professional identities can be socially constructed, transformed, and negotiated through collaboration and moderation (Adie, 2013; Beijaard, Meijer, & Verloop, 2004; Dodson, 2015; Gitlin, 2001; Hokka, Etelapelto, & Rasku-Puttonen, 2012).

In a case study of two middle schools examining teachers’ decision making, Gitlin (2001) determined the structural constraints within schools can guide teachers to make decisions that are hazardous to students. Rather than taking part in assessment practices that focused on individual
student learning, teachers relied on practices that saved time like rote learning and multiple choice questions. The teachers made decisions to contain the threat of intensification by the administration. The school environment and dialogue between teachers shaped the planning and implementation of their assessment decisions.

In a similar study, Adie (2013) observed how middle school teachers negotiated a shared meaning of achievement standards through dialogue. Adie examined how the process of moderation led the teachers’ to renegotiate their assessment identity. The assessment identity of the teacher was integral in the judgment of grading decisions. As stated by Adie, “This discussion has shown how a shared understanding of a standard can develop for teachers that is, quite often, a new way of understanding a standard, and a new identity of oneself within the practice” (p. 103). Teachers’ identity not only informed their assessment decisions, but their discussions with other colleagues about their practices helped to negotiate a new assessment identity.

In an analysis of research on identity (Beijaard, Meijer, & Verloop, 2004), negotiation was considered a dynamic process that intertwined the external pressures from society with internal expectations to make sense of self. The main finding from Hokka, Etelapelto, and Rasku-Puttonen (2012) was that professional agency related to research was strong in the construction of teachers’ identities as “researchers.” Teachers who lacked resources had a lack in research agency but the teachers’ research identity was separate from their teacher identity. The teachers’ juggled multiple identities and one identity did not rely on the other.

According to Holland et al. (1998) individuals acquire multiple contradictory identities through participation in socially organized positions within figured worlds as social agents. Depending on the societal context, teachers’ have the capacity to self author multiple assessment
identities that are contradictory and may change based on positioning and power relations. Dodson (2015) determined that as a result of the structural and societal environment, teachers adjust their assessment practices toward mechanical forms when external pressures increased. Due to fatigue, teachers re-authored their position, changed their assessment decisions, and in turn altered their assessment identity.

A study by McMillan and Nash (2000) examined the assessment decision-making process of 24 teachers and how they balanced internal beliefs with external pressures and realities of the classroom. In other words, this study highlighted the process through which teachers authored their evolving assessment identities. The six themes identified in the decision-making model included (a) teacher beliefs and values (b) classroom realities (c) external factors (d) teacher decision making rationale (e) assessment practices, and (f) grading practices. According to McMillan and Nash, the external factors imposed on the teachers may have led to tensions between teachers’ beliefs about assessment and the reality of assessment in the classroom. External factors included: mandated standardized standards, high stakes testing, district assessment policies, and pressure from parents. McMillan and Nash suggested that the teachers in this study were constantly balancing their beliefs about assessment with the realities of the classroom environment and external context.

The teachers in the study by McMillan and Nash (2000) negotiated their assessment identities by taking into consideration external pressure imposed on them to use objective assessments aligned to high stakes testing. Upon analysis, five types of assessment identities emerged. Each of the identities was influenced by external pressures. The first identity negotiated the pressure of using objective assessments by weighing the grades more on homework and in class activities. The second identity would “pull for students” by modifying
assessments to allow for creative expression or by having students complete revisions. The third identity modified assessments to promote student learning and incorporated higher level questions requiring students to show work and apply what they have learned. The fourth identity accommodated for individual differences by providing multiple versions of assessments tailored to specific learning styles or ability. The fifth and final identity modified assessments to mirror homework questions, motivated students to stay engaged by having a participation grade, and kept students on task using a “goody jar”.

The five identities determined by McMillan and Nash (2000) represent the variety of scripts teachers self-author to accommodate their personal beliefs and external pressures from society. Their scripts are not permanent, they may change over time or teachers may combine two contradictory identities depending on external pressures. As stated earlier by Holland et al. (1998), authorship is not a choice but how individuals respond is not predetermined. Teachers are positioned in figured worlds that are socially constructed, but how they script their agency in those worlds will in turn re-author their identity.

**Making Worlds**

Holland et al. (1998) suggested that when identities change through individual agency and improvisation, figured worlds may also change or expand as a result of human agency. It is important to remember; however, that according to Pennington (2007) and Thomas (2005) teachers inhabit figured worlds with little power compared to the figured worlds of policy-makers. Although teachers can negotiate their identity within the teaching figured worlds, they are still influenced by more powerful figured worlds. Pennington (2007) addressed the power of policy makers over teachers stating:
When policy makers script the meaning of educational assessments and research, they control the teaching environment. Teachers need to be able to return to their positions as the authors of their students’ learning experiences. Teachers must be well versed in the policy interpretations of teaching and assessment while also modifying and working the system to best reach the children. Being positioned at the bottom of the hierarchy makes this difficult and may require teachers to increase their political and professional savvy. (p. 471)

Understanding that assessment is a shared artifact between the two worlds of policy and teaching, teachers can use assessment as a tool for “accessing power, authorship, and making new worlds” (Pennington, p. 471). The problem is that the two worlds interpret assessment differently. Policy-makers are in position of power, which may lead teachers to negotiate their assessment identity to align with policy-makers.

Through agency and improvisation, teachers can construct new figured worlds where they can re-author their scripts and transform the meaning of assessment in other figured worlds. Pennington (2007) states that teachers need to stay politically literate in order to gain access into figured worlds of policy or create new figured worlds that have more power. As described by Sloan (2006), “the boundaries between figured worlds are porous and overlapping” (p. 145). Sloan examined the identities and agency of three elementary school teachers in the figured world of “school”. Of the three teachers, Anne “the born teacher” obtained the knowledge and ability to navigate between, and occupy several figured worlds. Although the district adopted test-explicit assessment practices undermining Anne’s self-authored assessment identity, she was able to successfully defend her position against the mandates to the school board. Anne’s strong teacher identity and confidence with dialogue in the figured world of policy guided her in advocating for what was best for students. Rather than complaining about the mandated policies, Anne had the ability to effectively communicate to individuals across figured worlds and negotiate her teacher identity.
Holland et al. (1998) stated that teachers can be offered positions that they can accept, reject, or negotiate through their own sense of agency and dialogue. Teachers’ identities are also altered or negotiated through their agency within and across figured worlds. Bower (2012) identified three identities: the “believer,” “opposer,” and “hopeful” in the figured world of school culture and teacher identity. The believer accepts mandates and agrees with new positioning. The opposer rejects mandates and does their “own thing” without changing their identity. The hopeful may take on changes but is capable of negotiating positioning by questioning or tinkering mandates. In the case of Anne, the born teacher, she would be considered to have a hopeful identity. She was able to step out of the “teacher’s box” (Vetter, 2012) and through improvisation and agency self-authored a position in a new “imagined” figured world. Although each of the teachers’ identities responds to their social contexts differently, all of the teachers saw themselves to be effective teachers. The teachers could potentially position themselves into three different figured worlds of assessment identities where each world has its own system of meaning and utilizes different assessment artifacts, discourses, and practices.

**Teacher Assessment Identity**

Originally referenced by Adie (2013) in her study on the process of teacher moderation, teacher assessment identity (TAI) was a term used to address teachers’ perceptions of themselves as assessors. Looney, Cumming, van Der Kleij, and Harris (2017) re-conceptualized TAI and the role of teachers as assessors to include multiple dimensions. Upon qualitative analysis after reviewing teachers’ self-report scales of their identity in relation to assessment, Looney et al. identified five emergent dimensions of TAI. The dimensions of TAI include: a) assessment knowledge and skills, b) beliefs about assessment, c) confidence in assessment knowledge, d)
assessment practices, and e) overall disposition of how they view their assessment role. Looney et al., emphasized these dimensions in their model of TAI as “I know,” “I feel,” “I believe,” “I am confident,” and “My role” which goes beyond teachers’ assessment literacy, knowledge, and skills. According to Looney et al., the consolidation of teachers’ assessment knowledge, skills, beliefs, feelings, and dispositions, “inform how teachers engage in assessment work with students, and focuses not simply on what teachers do, but on who they are” (p. 16). Therefore, Looney et al., considers TAI to be a dynamic and interactive interweaving of who teachers’ are including their conceptions, beliefs, experiences, and feelings in the process of assessment and in their role as an assessor.

TAI, according to Mockler (2011), is conceptually more complex than teacher assessment literacy or the role as teacher since it encompasses who teachers are when making assessment decisions “lending itself to multiple interpretations and perspectives” (Looney et al., 2017, p. 6). Teachers’ conceptions of their identity as assessors is one of many sub-identities (Beijaard, Meijer, & Verloop, 2004) associated with their professional identity as a teacher. As stated by Pryor and Crossouard (2010), “The different identities of the educator as assessor, teacher, subject expert and learner all involve different divisions of labour and rules shaping their interaction with students” (p. 10). Therefore, teachers move in and out through their roles as facilitator and assessor of student learning. Ecclestone and Pryor (2003) addressed the dual roles of teachers as both supporters and critics of student learning. Teachers need to take on the role of instructor and judge. Looney et. al (2017) addressed the duality and complexity of teachers having mixed feelings toward assessment by stating that some teachers, “may consider that some assessment processes should not be a part of their role as teachers and in their interactions with
students” (p. 14). Thus, teachers’ feelings and emotions are important dimensions of their assessment identity.

As new initiatives and assessment practices are introduced from outside pressures, teachers are also negotiating their identity as assessors (Looney et al., 2017). According to Xu and Brown (2016), teachers negotiate their identity as assessors within interactions with others during times of change. For example, the adoption of NGSS and three-dimensional assessments is a new mandate within the dominate structure of standardization. As high school science teachers navigate through the shift to NGSS, they will also negotiate their assessment identity through their assessment decision making in developing three-dimensional assessments. In summary, TAI is a dynamic concept that consists of teachers perceptions of how they see themselves as assessors; shaped by their assessment conceptions, experiences, beliefs, feelings, knowledge, and skills.

Conclusion

The purpose of this literature review was to examine the history of science standards, assessment and examine the elements of teachers’ assessment decisions. There are many inconsistencies of classroom assessment and even with professional training teachers’ tend to rely on practices they are familiar with or feel strongly towards.

Sociocultural Identity Theory provides a framework to better understand how teachers’ assessment identities inform their assessment decisions and how their decisions in turn construct their identities. Assessment decisions are made by teachers on a daily basis. Teachers’ self-author their assessment identities through improvisation and agency of their assessment decisions within figured worlds. Through positioning in the figured worlds of teaching, teachers
may accept, reject, or negotiate identities offered; and construct their identities through dialogue and use of artifacts.

By recognizing the external pressures placed on teachers from more powerful figured worlds (policy-makers, administrators, public, parents, test-makers), Sociocultural Identity Theory provides insight on how teachers constantly balance their beliefs with the realities of the classroom in making assessment decisions. Teachers can change their identities by repositioning themselves or by being positioned by others to imagine, prepare, and enact new roles. Therefore, assessments are socially constructed, systems of meaning within figured worlds. Understanding how teachers are positioned, have little access to, or are not included at all in a particular figured world informs the decision-making process of teachers.

In conclusion, Zoekler (2007) ended his study with the sentence, “Because of the complexity of moral issues in grading, a true picture of the teacher’s demanding task of assigning grades on a regular, even daily, basis can only be accurately revealed by fully examining the moral issues involved and considering the whole picture rather than limiting its scope to things which are easily measured” (p.101). Assessments are determined by a combination of thoughtful (and not so thoughtful) decisions. The “why” and “how” teachers make assessment decisions needs to be explored more and these are not “easily measured.”
CHAPTER 3

METHODOLOGY

The purpose of this phenomenological study was to examine high school science teachers’ perspectives on their decision making in developing three-dimensional assessments aligned to NGSS, through a Sociocultural Identity Theory lens. This study was guided by these two research questions:

1) How do high school science teachers describe their processes of decision making in the development and use of three-dimensional assessments?

2) How do high school science teachers negotiate their identities as assessors, individually and collaboratively, in designing three-dimensional assessments?

This chapter will discuss the design, participants, data collection, and data analysis for this study.

Research Design

According to Bogdan and Biklen (2007), qualitative research possesses the following attributes: it (a) occurs in the actual settings; (b) contains descriptive data; (c) emphasizes the process; (d) is inductive in data analysis; and (e) is concerned with meaning. Furthermore, as stated by Merriam (1998), qualitative research seeks to “understand the meaning people have constructed, that is, how they make sense of their world and the experiences they have in the world” (p. 6).
This study focused on “how” research questions, which can best be answered through an in-depth qualitative approach. Therefore, to make sense of high school science teachers’ decision making in developing three-dimensional assessments, qualitative methods provided a richer description than quantitative methods of the phenomenon (Mertens, 2015; Patton, 2002).

Through the voices of high school science teachers, a phenomenological research study provided descriptive data to examine how high school science teachers perceive their decision-making experiences. According to Mertens (2015), a distinguishing characteristic of phenomenological studies, compared to other qualitative research, is the focus on individual’s perceptions of a phenomenon. This study focused on teachers’ subjective experiences and perceptions of their decision-making processes in developing and using three-dimensional assessments.

The Site Selection

As a sample of convenience (Merriam, 1998), I chose the high school where I am employed as the site for the phenomenological study. According to Mertens (2005), “Convenience sampling means that the persons participating in the study were chosen because they were readily available” (p.322). Along with having the ability to quickly access teachers in a science department, I have a depth of knowledge in regards to the district’s history of science assessments.

Although it may be a matter of convenience, the science department from Cottage Hill High School (pseudonym) in Unit District 355 (pseudonym) was selected for multiple reasons. While other nearby high schools have yet to change their curriculum, Cottage Hill High School science teachers are now in the second year of implementing NGSS and are knowledgeable of
three-dimensional learning. Due to the paradigm shift in science education from knowing science to doing science, teachers at Cottage Hill High School are learning how to use the three-dimensional standards and rethink their assessment practices. The teachers have had a variety of professional development in designing assessment in order to implement one NGSS unit in the 2016-2017 school year. Teachers are tasked with redesigning all of their curriculum and assessments by the 2017-2018 school year. What also makes Cottage Hill unique from other high school districts in the area is that the science teachers work in a collaborative environment and have been designing common assessments for the past 12 years.

The School District Setting

Cottage Hill High School is a high performing school in an affluent suburban community outside a large Midwest City. According to the United States Census Bureau (2010), the projected median income in 2015 was $96,486. In addition, 2017 Best Schools by Niche.com, Inc., ranked Cottage Hill number 24 out of 285 as Best High School for Science, Technology, Engineering, and Math (STEM) in the metropolitan area based on statistics and survey data provided by parents and students. Cottage Hill is known for academic excellence.

Cottage Hill High School is known for excellence in science teaching. Teachers in the science department have been awarded national awards including: the National Association of Biology Teachers (NABT) Outstanding Biology Teacher Award and the American Association of Physics Teachers (AAPT) Physics Teacher of the Year Award. The majority of the science department has Master’s Degrees and two have Doctoral Degrees. It is also common for science teachers at Cottage Hill to attend, as well as, present in national and state conferences.
The School Setting

Cottage Hill High School is the only high school in Unit District 355. According to the district’s website, the mission of Unit District 355 is, “…to meet the educational needs of all students, challenging each to his or her full potential and ensuring a foundation for future success in life” (District website, 2017). The vision statement includes incorporating, “…best practices in education, the highest caliber educational professionals, and leading edge resources to ensure an equitable education for all and success in a global society” (District website, 2017).

Cottage Hill High School is composed of 2,682 students comprised primarily of Caucasian, upper middle class families. According to the 2015-2016 Illinois Report Card, the ethnic breakdown of the school is: 75% Caucasian, 13.8% Hispanic, 5.5% Asian, 3.1% Black, 0.1% American Indian, and 2.4% two or more races. The percentage of low-income families is 13.6%, percentage of Limited-English-Proficient is 1.8%, and percentage of IEP is 11.8% (Illinois School Report Card, 2016).

The students at Cottage Hill have a variety of AP course opportunities, clubs, activities, athletics, and supports. This is mostly due to high involvement from student families, ambitious instruction, and a supportive environment from dedicated teachers (Illinois School Report Card, 2016). According to the Illinois Report Card, Cottage Hill has an 85% teacher retention rate and 80.1% of teachers who miss 10 or less attendance days, which provides more insight as to the level of professionalism teachers at Cottage Hill possess.
The Science Department

This phenomenological study focused on teachers in the science department of Cottage Hill High School. According to the science department website, the mission of the department is, “...to inspire minds to inquire, think critically, and make informed decisions allowing students to have a positive impact on society” (Science Department Website, 2017). In the past 20 years, there have been five department chairs. The current department chair has been in the role for the last two years. The department consists of 21 teachers, including myself and the department chair who teaches one class.

In the fall of 2005, the science department chair at the time implemented common assessments for all courses. To do so, collaboration teams were developed along with a common plan time. The implementation of common assessments ignited the department to become very collaborative and is now considered a model department in the school for collaboration. For example, the teachers’ desks in the science office are arranged in pods by collaboration team so that teachers can make assessment decisions with their teams as often as possible.

Overall, the science department continues to be known as a collaborative, professional, reflective, and functional department at Cottage Hill. With the implementation of NGSS, the department chair has spearheaded in-house professional development, encouraged teachers to seek outside resources, and developed a website to share all of the information gathered. Currently, there are teachers who are designing three-dimensional assessments, as well as, teachers who are continuing to understand how to design three-dimensional assessments.
Science Teacher Participants

High school science teachers (those who teach grades 9-12), male and female, within the science department at Cottage Hill High School served as the population from which the participant sample was drawn. First, the details of the research study were discussed with the science department chair. Second, after receiving the science department chair’s approval, the science teachers in the department were emailed a brief summary and purpose of the study. During the next science department meeting, the science department chair set aside time for me to provide more details and offer an opportunity for them to ask more questions. The teachers were also provided a Letter of Consent (Appendix A) to sign in order to participate in the study.

Once science teachers who volunteered were identified and were willing to participate, purposeful criterion sampling (Bogdan & Biklen, 2007; Patton, 2002) was utilized. The initial criteria set in regard to participants include: (a) teacher holds a valid teaching certificate in the state of Illinois; (b) teacher will be a part time or full time employee as a science teacher in the district for the 2016-2017 school year; (c) teacher must be familiar with developing assessments aligned to NGSS; and (d) teacher will consent to participate in a minimum of one focus group, and if chosen, possibly a series of two to three interviews (Seidman, 2013) and think-aloud session.

All 19 science teachers in the department volunteered to participate in one of the four focus groups. Every teacher who participated in the study signed a Letter of Consent. Pseudonyms were used to identify participants, and they were given the option to choose their own name. Table 1 lists the pseudonyms of the teachers along with their years of experience and courses they taught during the time of data collection.
Table 1  
*High School Science Teacher Participants*

<table>
<thead>
<tr>
<th>Pseudonyms of Participants</th>
<th>Years of Teaching Experience</th>
<th>Courses Taught During 2016-2017 School Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frederick</td>
<td>2</td>
<td>Chemistry, Key Ideas Chemistry</td>
</tr>
<tr>
<td>Ernest</td>
<td>23</td>
<td>Biology, AP Environmental Science</td>
</tr>
<tr>
<td>Cal</td>
<td>10</td>
<td>Physics, Honors Physics, AP Physics</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>7</td>
<td>Biology, Key Ideas Biology</td>
</tr>
<tr>
<td>Claire</td>
<td>12</td>
<td>Honors Biology, Environmental Science</td>
</tr>
<tr>
<td>Max</td>
<td>2</td>
<td>Chemistry, Physics</td>
</tr>
<tr>
<td>Emily</td>
<td>3</td>
<td>Honors Biology, Animal Behavior</td>
</tr>
<tr>
<td>Samantha</td>
<td>6</td>
<td>Chemistry, Key Ideas Chemistry</td>
</tr>
<tr>
<td>Saylor</td>
<td>12</td>
<td>Honors Biology, Microbiology, AP Biology</td>
</tr>
<tr>
<td>Isla</td>
<td>11</td>
<td>Physics, Honors Physics, AP Physics</td>
</tr>
<tr>
<td>Sue Ellen</td>
<td>22</td>
<td>Honors Biology, Genetics, Med Careers, AP Biology</td>
</tr>
<tr>
<td>Esther</td>
<td>3</td>
<td>Biology, Key Ideas Biology, ELL Biology</td>
</tr>
<tr>
<td>James</td>
<td>18</td>
<td>Honors Chemistry, AP Chemistry</td>
</tr>
<tr>
<td>George</td>
<td>16</td>
<td>Honors Chemistry, Physics</td>
</tr>
<tr>
<td>Eli</td>
<td>16</td>
<td>Honors Physics, AP Physics C</td>
</tr>
<tr>
<td>Chris</td>
<td>23</td>
<td>Honors Chemistry, Forensics</td>
</tr>
<tr>
<td>Dylan</td>
<td>1</td>
<td>Chemistry, Key Ideas Biology</td>
</tr>
<tr>
<td>Drea</td>
<td>12</td>
<td>Biology, Sports Medicine</td>
</tr>
<tr>
<td>Mary Ann</td>
<td>11</td>
<td>Biology, Animal Behavior</td>
</tr>
</tbody>
</table>

Data Collection

The three subsections within this section correspond to the three phases of the data collection process: focus groups, interviews, think-alouds, and document review.

**Phase One: Focus Groups**

Once teachers volunteered, they were arranged into four groups, a number range of focus groups considered a “rule of thumb” (Krueger & Casey, 2009; Mertens, 2015; Vaughn, Schumm, & Singaub, 1996). Methodology experts recommend that focus groups consist of five to ten
people with similar characteristics being studied (Krueger & Casey, 2009; Morgan, 1997). For this study, focus groups consisted of four to six participants to allow ample time for participants to answer questions fully and have rich discussions. The benefit and value of conducting focus groups is to gain additional insight from studying the interactions and discourse among the participants that could not have been done through interviews alone (Mertens, 2015). Interviews are more researcher-directed whereas focus groups enable the conversation among the participants to flow naturally (Krueger & Casey, 2009).

Each teacher participated in one of the four focus groups. Of the four focus groups, half of the focus groups were arranged homogeneously. The homogenous focus groups consisted of science teachers from the same course team. For example, Focus Group #1 included four teachers from the Biology team and Focus Group #2 included four members of the Physics team. Therefore, the other two focus groups were arranged heterogeneously. Thus, Focus Group #3 and Focus Group #4 consisted of science teachers from a variety of course teams. For example, Focus Group #3 and #4 had at least one teacher representing the Biology, Chemistry, and Physics team. The purpose for the various arrangements of science teachers in the focus groups was to encourage discourse among teachers from the same or different content areas; however, all of the teachers had the opportunity to share experiences in developing assessments aligned to NGSS.

Focus groups took place classrooms when convenient for the teachers participating and lasted approximately 60 minutes for all four. The size of the groups ranged from four to six teachers. Appendix B provides details of the four focus groups including pseudonyms of who participated in each focus group and when the focus group occurred.
According to focus group guidelines from Krueger and Casey (2009), focus group questions were sequenced and categorized into five categories (Appendix C). The categories are opening questions, introductory questions, transition questions, key questions, and ending questions. Upon transcription of the focus groups, participating teachers were provided the transcript to check for accuracy and created an opportunity for them to include additional comments or insights.

The focus group protocol was field tested with a pilot group of high school science teachers prior to data collection for credibility. To do so, six high school science teachers from different high schools, who have a professional relationship with the researcher, were invited to participate in a pilot focus group on March 24, 2017 from 4:45-5:45 P.M. The informed consent forms for the pilot study can be found in Appendix D. The pilot focus group identified questions that needed to be modified for clarity as well as provided insight on questions to add that would lead to more discourse. For example, “Describe your interactions with teachers in your team when making assessment decisions” was a question developed during the pilot focus group that was added to the focus group protocol.

Phase Two: Interviews and Think-alouds

Interviews

Although focus groups provide rich data in a short amount of time (Bogden & Biklen, 2007), interviews help to make meaning of the teachers’ reflections on their assessment decision making. The value of interviews is that they provide an opportunity for teachers to share insights and experiences that they may not feel comfortable sharing in a larger group. Eight teachers, who participated in a focus group, were asked to participate in a series of two to three interviews
(Seidman, 2013). Utilizing purposive criterion sampling, teachers were selected from the focus groups according to their discourse about their assessment practices. The three possible types of assessment practices discussed included: traditional methods, traditional but attempting to incorporate three-dimensional assessments, and mostly incorporates three-dimensional assessments. Overall, the teachers selected for follow up interviews represented a variety of perspectives related to three-dimensional assessments.

For this study, Seidman’s (2013) three interview series was used to learn about the meaning behind the reasons for teachers’ assessment decision making (Appendix E). The first interview focused on the life history of the science teacher, the “how”, and not the “why”. For example, “Tell me the story of how you became interested in teaching science” and “Tell me about your early experiences on how you developed science assessments.” The second interview elicited details of lived experiences mentioned in the first interview focused on the details of relationships and reconstructing experiences. Sample interview questions included, “Based on your early experiences in developing science assessments, explain how decisions of what to include or not to include were made” and “Walk me through the process of how your collaboration team decided on how the assessment was designed.” The third and final interview elicited time for reflection of the meaning that the teacher attaches to the lived experiences of developing assessments. For instance, “After going through the think-aloud, what are some of your reflections” and “Explain the reasoning behind your final decisions in creating that assessment.” Teachers were asked to participate in a think-aloud before the final interview. The think-aloud process will be explained in the next section. All eight teachers brought the assessments they developed during the think-aloud process with them to the final interview session.
Although the three interview series is designed for three interview sessions, Seidman (2013) suggests that there could be alternatives to the structure and spacing of the interviews. Due to unanticipated circumstances, Seidman suggests that the first and second interview could be conducted on the same day. Additionally, Seidman suggests that if a participant may be going out of town, all of the interviews could be conducted in one day. Therefore, teachers were provided the choice as to the structure and time of their interviews depending on their availability. Thus, interviews were conducted when and where it was convenient for the teacher and lasted approximately 30-60 minutes each depending on the interview structure. Appendix F provides specific details including pseudonyms of interview participants and when their interviews and think-alouds occurred. Seven of the eight teachers had interviews on three separate sequential days. One teacher chose to complete interviews #1 and #2 on the same day for convenience of time. All of the teachers completed a think-aloud before participating in their last interview. Upon transcription of the interviews, participating teachers were provided the transcripts of their interviews to check for accuracy and provide an opportunity to include additional comments or suggestions.

The interview protocol was field tested with one teacher from the pilot study focus group, who will be referred to as Ellie. Due to Ellie’s availability, she chose to participate in field testing of the interview questions by utilizing an alternative structure. Ellie completed interview one and two in one session, the think-aloud protocol before interview three, and then brought the think-aloud assessment with her to the final interview session. The pilot interview process provided feedback as to which questions needed to be slightly modified for clarity.
Think-alouds

The eight teachers, who participated in the three interview series, were asked to participate in one think-aloud before their final interview session. The date when the participants recorded their think-aloud was included in Appendix F. According to Ericsson and Simon (1993), think-alouds can often provide some cognitive insights of their thought processes as they complete a task. The value and purpose of using the think-aloud process was to listen to the voices of teachers and gather information specifically related to teachers’ thoughts, emotions, feelings, and processes while making assessment decisions. The teachers recorded themselves talking out loud as they developed a classroom assessment of their choice, using a digital voice recorder on their cell phone.

Based on suggestions from Jääskeläinen (2010), the think-aloud protocol (Appendix G) was developed and provided to the teachers at the end of the second interview. The protocol explains the steps they performed to complete the task. The protocol provided possible prompts for the teachers to use as a guide, especially if they stopped talking. The teachers completed the think-aloud process within 10-20 minutes. All of the think-alouds were performed at the discretion of the teacher and out of my view; so that my presence would not influence the teachers thought processes (Ericsson & Simon, 1993). The teachers emailed the digital voice file from their think-aloud prior to the final interview, as well as brought the classroom assessment that they developed to the interview. Upon transcription of the think-alouds, participating teachers were provided the transcripts to check for accuracy and create opportunity to include additional comments or insights.

The think-aloud protocol was field tested with Ellie from the pilot study, who volunteered to go through the interview process. She followed the think-aloud protocol, recorded herself
using a digital voice recorder app on her phone, emailed the digital file, and brought the classroom assessment that she developed while completing the think-aloud to the last interview session. Ellie was asked to provide feedback and suggestions about the think-aloud process in order to make improvements where necessary. Ellie suggested that participants should read through the prompts provided on the think-aloud protocol prior to completing the think-aloud process so that they understood what was expected. Also, in consideration of time and practicality, Ellie suggested that participants should develop their assessments first and then complete the think-aloud immediately afterwards. Both of these suggested were implemented by the researcher.

**Phase Three: Document Review**

According to Merriam (1998), document review can “ground an investigation in the context of the problem being investigated” (p. 126). Therefore, the value of document review of the artifacts collected throughout the study is that it provided rich data for analysis. Thus, review of documents in this study provided the context of three-dimensional assessments, as well as, provided an opportunity to draw together the thick descriptions provided from teachers in four focus groups, 23 interviews, and eight think-alouds.

With respect to this study, the documents to be reviewed included assessments developed by individual teachers and course teams, as well as any assessment tools and rubrics. According to Mertens (2005), documents do not only include paper products but may also include plans, reports, tapes (audio and visual) and other artifacts. Therefore, any other teacher materials used in planning and developing assessments were reviewed.
The documents reviewed were collected at different points of the study. Teachers were invited to turn over documents upon completion of each focus group. An envelope was placed in the science department for the teachers to place artifacts in relation to their discussions. The artifact envelope was collected once all focus groups were completed. All documents remained anonymous and confidential. Additionally, assessment artifacts were collected from interview participants at the final interview session. The documents were directly handed over at the interview.

Data Analysis

This section provides information about how the data that will be collected through focus groups, interviews, and document review will be analyzed and assessed for trustworthiness. The three subsections include transcription procedures, coding procedures, and assurance of trustworthiness.

Transcription Procedures

Through the use of a digital voice recorder, all focus groups, interviews, and think-alouds were recorded and stored in a secure password protected digital file folder. All digital voice recording files will be destroyed upon completion of this dissertation. Upon completion of focus groups, interviews, and think-alouds the data was transcribed electronically into a word processing document. Pseudonyms chosen by teachers prior to data collection were used during the transcription process. Transcripts included all information recorded electronically. Multiple copies of the transcripts were produced in order to conduct coding and trustworthiness procedures.
Coding Procedures

Once the transcription process was completed, the transcripts from the focus groups and interviews, as well as the documents collected from the teachers, went through two cycles of coding. Initially, all transcripts and documents were read from beginning to end prior to coding to develop a “start list” (Saldaña, 2013) of codes. Saldaña refers to this initial, exploratory method as “Provisional Coding.” According to previous empirical research that has explored teachers’ assessment decision making (Kawasaki, 2015; Daghan & Akkoyunlu, 2014; Izci & Siegel, 2015), provisional codes included: teachers’ assessment knowledge, teachers’ roles, colleague support, teachers’ assessment philosophy, and teachers’ pedagogy.

After generating a list of possible codes, the first cycle of coding began, consisting of both “Emotion Coding” and “Theming the Data” (Saldaña, 2013). According to Saldaña, “Emotion Coding is appropriate for virtually all qualitative studies, but particularly for those that explore intrapersonal and interpersonal participant experiences and actions” (p. 105). Focus groups and interview questions elicited emotional, personal, and sometimes contentious discussions regarding teachers’ reasons for their assessment decision making. For instance, some of the emotion codes included: fear, shame, anxiety, frustration, tension, and joy.

Along with Emotion Coding, I also “Themed the Data” (Saldaña, 2013) during the first cycle of coding. As Saldaña (2013) states, “A theme is an abstract entity that brings meaning and identity to a recurrent [patterned] experience” (p.175). This type of coding is applicable to data collected from interviews and artifacts (Saldaña). Thus, after reading through all of the data collected in the first cycle, similar codes that repeatedly emerged were organized into themes. Themes included “Tensions with the NGSS language” and “Teachers roles within a collaboration team” which further developed as more data was categorized under those themes.
Upon completion of first cycle coding, second cycle “Focused Coding” (Saldaña, 2013) was conducted. According to Saldaña (2013), “Focused Coding searches for the most frequent or significant codes” (p. 213). Therefore, once the data was interpreted through the use of Emotion and Themed Coding, I determined which super-ordinate themes were highly supported by the data. The emergent themes that had a higher frequency were developed into major themes or categories. Through the lens of the Sociocultural Identity Theory, “categories of categories” (Saldaña) were created, which developed into four “key assertions” (Saldaña) related to the research questions, and are discussed in the findings included in Chapter 4.

Assurance of Trustworthiness

Three different processes were used as credibility and dependability procedures in analyzing the data collected in this study. The first process was member checking (Vaughan et al., 1996) where participating teachers were provided transcripts of focus groups, interviews, and think-alouds to check for accuracy. The next process included peer review (Merriam, 1998) in which the data analysis was checked by two science teachers with advanced degrees. Finally, memoing (Corbin & Strauss, 2009) of possible key assertions was conducted.

Upon completion of transcribing both focus group and interview data, the teachers involved in producing that data were provided a copy of the transcript, via email, to review and member check for accuracy. The teachers were given a month to make corrections or provide feedback directly onto their copy of the transcription. The transcripts were recollected; however, no corrections were provided by the teachers.

Once the themes, categories, and key assertions were identified, two high school science teachers, with advanced degrees, who have experience with qualitative research, peer reviewed
the coding procedures and emergent themes to establish credibility and dependability of the analysis process. Upon affirmation of emergent themes and categories through the peer review process, possible key assertions were memoed prior to including the strongest assertions in Chapter 4.

Researcher Role

At the time of this study, I had 15 years of experience as a high school science teacher and taught at Cottage Hill High School for the last 12 years. Over the years, I have had experience teaching a variety of science courses including: biology, chemistry, and physics. In the year when data was collected, along with teaching chemistry, I took on the role of instructional coach to provide job-embedded professional development for teachers at Cottage Hill. The science department at Cottage Hill is majority Caucasian women between the ages of 25-42. Compared to the demographics of the department, I fit within that demographic.

Throughout my tenure, I have been provided the opportunity to take part in teacher professional development on various topics including: instructional strategies for student engagement, standards-based assessment, and incorporating NGSS into the chemistry curriculum. I also attended training given by members of the NGSS writing team to learn how to unpack the three-dimensional standards, bundle standards around phenomenon, and design assessments that address performance expectations. Overall, I have a high familiarity with NGSS and am very knowledgeable of three-dimensional assessments. I am a strong advocate of NGSS and recognize the need to change science education from knowing science to doing science. I continually strive to design learning experiences and assessments that emphasize engineering
practices and cross-cutting concepts. Thus, my beliefs and educational philosophy highly aligns with the NGSS three-dimensional framework.

Although I have not spoken openly to the teachers in the department about my educational beliefs, the actions in my classroom and role as an instructional coach may have influenced some of the teachers’ perceptions of me. The science teachers may perceive me as a progressive teacher who is open to trying new strategies and a leader in the science department. For example, because I have provided professional development to all the teachers at the school about formative assessment and grading practices, it is important to recognize that this may have influenced the teachers’ responses or thought processes during the focus groups, interviews, and think-alouds.

Although I perceive myself as an insider and an equal to the teachers in the department, this may not be the perception for all the teachers in the department. For example, because I am both a teacher and instructional coach, some of the teachers may no longer see me as an equal in the science department. Even though instructional coaching is non-evaluative, it does change my role as an educator at Cottage Hill. For instance, as an instructional coach, I engage in coaching cycles with teachers that include classroom observations, reflective conversations, and provide support for teachers when changing their instructional and assessment practices.

However, because the teachers in the study already have a trusting relationship with me, they may have felt more comfortable providing rich descriptions than if I was a stranger. The conversations in some of the focus groups and interviews became very emotionally charged. Many teachers felt very comfortable opening up to me and have authentic conversations. For example, one teacher told me after the interview series ended that she felt comfortable saying things to me because I am her peer, rather than an outsider or an evaluator. Another teacher
became so emotional during interviews that he felt comfortable enough to show his emotions by
shedding tears and using profanity when discussing his experiences with assessment
development during personal interviews. This was something that I was not expecting
considering that he is a more experienced teacher and someone who I did not have a very close
relationship with.

It is also important to mention that I have shared common experiences with the teachers
in the study that may have been unrevealed to an outside researcher. For instance, I have deep
contextual knowledge and awareness of the department’s previous work in the development of
common assessments and modifying curriculum and assessments to be more three-dimensional.
These common experiences may have provided more details during the analysis of the data.

Conclusion

This chapter began with a description of the phenomenological, qualitative methods used
in the study. Next, information regarding the site and participants were described. Then, the
three phases of data collection including focus groups, interviews, and document review were
discussed in detail. Following data collection, data analysis techniques were discussed, which
included transcription procedures, coding procedures, and trustworthiness procedures. The next
chapter, Chapter 4, provides the findings and analysis of the data collected during this stud
CHAPTER 4

REPORTING OF FINDINGS

Introduction

The purpose of this study is to examine high school science teachers’ perspectives on their decision making in developing three-dimensional assessments aligned to NGSS, through a Sociocultural Identity Theory lens. This chapter will review the two research questions and reveal the key assertions that emerged upon analysis of the data.

Research Questions and Key Assertions

Before discussing the key assertions that emerged from the data that was collected for this study, it is necessary to first readdress the two research questions.

1. How do high school science teachers describe their processes of decision making in the development and use of three-dimensional assessments?

2. How do high school science teachers negotiate their identities as assessors, individually and collaboratively, in designing three-dimensional assessments?

Two overarching key assertions materialized upon analysis of teachers’ descriptions of their assessment decision making in the main areas of: a) type of decision-making process, and b) what to assess. In addition, analysis of teachers’ negotiation of their identity as an assessor uncovered two key assertions in the main areas of teachers’: a) actions, and b) collaborative
relationships. The analyses of the four key assertions lead to the development of three assessment sub-identities. The three sub-identities include: the *modifier-recycler* (very little alignment to three-dimensional assessment decision making), the *feeler-finder* (negotiates alignment in making three-dimensional assessment decisions), and the *creator* (accepts alignment to three-dimensional assessment decision making and develops three-dimensional assessments).

Assessment Decision Making is a Process of Modifying, Feeling, or Creating

Teachers described their assessment decision-making process in one of three ways. The descriptions of the process include: a) slightly modifying or recycling previously written traditional assessments without aligning to NGSS, b) choosing or finding questions that feel good and may at times be three-dimensional or aligned to NGSS, and c) creating new three-dimensional assessments more aligned to NGSS. The next sections are arranged according to the three different descriptions of teachers’ decision-making process and the emergent assessment sub-identity.

A Process of Modifying: “Why reinvent the wheel…?”

Most teachers’ voiced how their assessment decisions were more about revising and adapting prior assessments rather than developing new three-dimensional assessments aligned to NGSS. They also voiced similarities in their early experiences with slightly modifying assessments and shared memories of more experienced teachers or administrators handing over assessments for them to administer when they began teaching. Specifically, one of the commonalities teachers shared was their reliance on test banks developed by publishers to find
assessment questions early on in their career. For instance, during one of the focus groups consisting of teachers from different course teams, the teachers revealed their experiences of using test banks as evidenced in the following conversation:

Saylor: Test bank! Right.
Esther: I used that too. During my student teaching we used test banks.
Saylor: I don’t know.
Frederick: I feel like as a new teacher, I don’t know, you guys have more experience than I do making tests for sure, but for me I see what’s out there, you know what I mean…
Claire: We still do!
Frederick: I mean, what can I use? Yeah…yeah…yeah…
Claire: Why reinvent the wheel when you can get ideas.
Frederick: Yeah, but it would only be like multiple choice and an essay question.
Claire: Yeah. (Focus Group #3, April 13, 2017)

As mentioned above, teachers used test bank questions at the beginning of their career and some still do today when modifying their assessments. However, test bank questions are not three-dimensional assessment questions aligned to NGSS. They are considered to be more traditional, multiple choice questions. For instance, it would be difficult to find a test bank question where students need to identify a pattern in order to analyze data related to a specific concept.

Frederick, a new teacher with only two years of experience, addressed in the conversation above that the use of test banks would result in multiple choice and essay questions. He recognizes that test bank questions are not three dimensional but they are culturally accepted in the figured world of accountability and standardization. Therefore, teachers’ choices to include test bank questions continue to persist.
Teachers also voiced their experiences of being handed assessments to give to their students by the school or district. During an interview with Sue Ellen, an Honors Biology, AP Biology, and Genetics teacher with 22 years of experience, she stated: “pretty much all along the way, I would say that tests were given to me to use” (Interview #1, April 27, 2017). As Sue Ellen voiced this statement, she also uncovered her feelings of the lack of power she experienced when making her assessment decisions. In other words, she didn’t have a choice but to use the tests that were provided to her. Additionally, in an interview with Saylor, an Honors Biology, AP Biology, and Microbiology teacher, she spoke of her lack of assessment writing experience stating:

I don’t think I developed science assessments early on? I think I used assessments that were handed to me from somebody else that had been in the department longer and decided to share with me. If I developed anything, it was more like modifying. (Interview #1, April 27, 2017)

Using Saylor’s term of “modifying,” she only felt comfortable modifying tests that she was given by teachers who had more years of teaching experience. Saylor and Sue Ellen did not feel that they were in a position of power to change the assessments they were given. Overall, the teachers’ expressed having very little experience designing and creating their own test questions early on in their careers; however, they have been making slight changes to questions over the years.

In the same focus group as mentioned earlier, Claire, Esther, George, and Saylor addressed that even though they are tasked with developing three-dimensional assessments they continue to modify their tests without aligning them to NGSS. Although these teachers are aware the NGSS mandate, their assessment practices of modifying past tests have not really changed. This is evident in the following dialogue:
Claire: There isn’t much of a thought process, because we do what we’ve always done.

Esther: Which is what?

Claire: Which is a certain number of multiple choice questions and then an essay; so, in that aspect if you’re looking at the summative assessment there isn’t a whole lot of discussion with the format.

George: I always try to look at what’s the most important topic, you know, and might have more questions on that, or what have we spent more time on. We might have more questions on that, sort of thing, so that’s what I’m thinking…

Saylor: Yeah.

George: …or when I’m kind of looking at the test, do we have a question that covers this?…or that? That we’ve been going over… (Focus Group #3, April 13, 2017)

As voiced in the dialogue above, teachers’ describe their assessment decision making as a process of revising a past assessment based on what was emphasized in their class. George is making slight changes based on the content that he spends the most time discussing in class. Claire is again addressing the traditional multiple choice and short answer assessment structure which is what she “has always done.” This conversation again reveals the teachers resistance to developing three-dimensional assessments.

Teachers’ also discussed relying on modifying assessments rather than developing NGSS aligned assessments when they felt short on time. During Saylor’s second interview, she revealed how the lack of time was a possible reason behind her resistance to creating three-dimensional assessments. Saylor commented:

The walking through the process of getting through the summative assessment (sigh) it’s always like, oh crap! The summative assessment is coming we need to change this…I guess we look at how they did on questions the previous year. (Interview #2, May 4, 2017)

Saylor’s response also reveals that modifying tests because there is a lack of time to create three-dimensional assessments is a common occurrence that is socially acceptable in the structure that
exists currently. Similar to Saylor’s comments, many of the teachers’ responses expressed comfort in the process of modifying previously created assessments from years past because it is what they are most familiar with. For instance, George, an Honors Chemistry and Physics teacher with 16 years of experience described his assessment decision-making process in the following statement:

It’s interesting for physics; it’s kind of like you kind of know what you need to get to. We already had the previous assessment from the previous year. I would think that would be tough to you know, go into a unit not knowing this is what I need to get to...This is like the third or fourth year we have been giving these assessments. (Focus Group #3, April, 13, 2017)

George uncovered in his response above that his pre-made assessments used in years past are a guide for him to get where he “needs to get.” In other words, his assessments provide him with the content that he needs to teach for students to be successful on the assessment. George goes on to say that it would be tough to “go into a unit not knowing this is what I need to get to.” Again, this is descriptive of a traditional multiple choice assessment focused around content knowledge. Therefore, traditional assessments are considered the norm and three-dimensional assessments would be considered radical. This is because three-dimensional assessments require students to perform or produce something using scientific content as the context for practicing a skill. This is not the type of assessment that George is describing in his statement above.

Along with responses that revealed comfort in their current assessment practices, teachers justified simply modifying and re-using their past assessments for personal reasons in regard to their resistance to NGSS. Cal, a Physics teacher with 10 years experience, does not consider his assessment practices to be aligned to NGSS. Cal stated, “I haven’t read through them enough to know exactly what they are [the three dimensions]...I haven’t made any sort of specific efforts to
align with them” (Interview #1 &2, May 8, 2017). Upon further conversation in an interview with Cal he revealed:

> I felt like when I read through them [the three dimensions of NGSS], it’s been things that we [the physics team] are already doing and we didn’t know we were calling them cross-cutting concepts...I feel that is kind of the reason why I haven’t studied them in depth because all of the times I looked at them I think that’s kind of what we’re doing. (Interview #1 & 2, May 8, 2017)

Although Cal does not align himself with NGSS, he does feel that he is already covering the three dimensions on his assessments even though they may not be woven together intentionally. Therefore, Cal has justification for making slight modifications on his assessments rather than designing new three-dimensional assessments. However, assessments are not considered three-dimensional unless the students are using cross-cutting concepts as a lens to do a science and engineering practice around a specific concept. It appears that Cal has a misinterpretation of three-dimensional assessments and NGSS.

Isla, a Physics teacher with 11 years of experience, also expressed how the physics tests already have components that incorporate engineering practices. For example, in an interview Isla stated, “...maybe not so much the multiple-choice part but the short answer section of a test or quiz. Those questions are more based off of what the students have done in lab” (Interview #1, May 4, 2017). Again, the socially acceptable multiple choice and short answer structure was revealed in this comment from Isla. However, she feels that because the questions are in reference to labs that the students completed in class then it is more of an application question. Therefore, Isla may feel that she only needs to slightly change traditional questions to make them more focused around science and engineering practices. Although application questions are more challenging it does not mean that students are doing science and engineering practices like
analyzing data, establishing an argument, or developing models. Isla’s assessments would not be considered three-dimensional or aligned to NGSS.

During an interview with Saylor, she openly and authentically revealed her lack of assessment alignment to NGSS and stated:

It’s just for good or for bad, I’m just not there yet and I guess that’s what you want are honest answers. So, I’m not there yet. I am aware of some of them. I’m aware of how I want to assess them compared to how I taught them, but I don’t specifically know those three design dimensions…(sigh). I want to apologize, but… (Interview #2, May 4, 2017)

As shown in the passage above, Saylor is aware of NGSS but is not fully aware of three-dimensional assessments or how to make one. Her apology towards the end of that passage shows her vulnerability and insecurity in her lack of NGSS knowledge. When asked explicitly how her assessment practices aligned with NGSS, Saylor apprehensively responded with, “Oy, most of the time honestly I don’t think they are” (Interview #1, April 27, 2017).

Although Saylor is not developing three-dimensional assessments, she is making slight changes or modifications to some of her assessments. Saylor stated:

I know in Microbiology, it is a class that I teach by myself, I’ve been making small adjustments to add in things...they learned it in class and now is this data set. Look through the data, apply what you know from what you’ve learned. This data set...I don’t even know if that’s totally...Trying to just not lead them to an answer but really make them apply what they have learned and reason it out with the data, or model in front of them. (Interview #1, April 27, 2017)

As seen in the passage above, similar to Isla, Saylor is adjusting some of her assessments to include data analysis, which considered a science and engineering practice, but she is not creating assessments that are three-dimensional. As Saylor expressed in her think-aloud, “Science and engineering practices, cross-cutting concepts, and disciplinary core ideas, honestly, I’m hoping that I hit some of these but I don’t intentionally try to” (Think-aloud, May 18, 2017). Saylor’s decisions are not aligned to NGSS.
Claire, an Honors Biology and Environmental Science teacher with 12 years experience, and Esther, a Biology teacher with 3 years experience, voiced similar sentiments as Saylor during a focus group conversation. While discussing three-dimensional assessments they stated:

Claire: ...and I’m going to be honest, we haven’t dove all the way in, but we are making progress and we are teaching ourselves along the way. It’s just slow. In the concept of changing, I think we’ve changed a little bit more of our formative assessments not necessarily our big summative at this point. Small steps.

Esther: But I think of everything about NGSS, I think the assessment part is the weakest. I don’t really think there’s anybody…

Claire: Who’s figured it out…? (Focus Group #3, April 13, 2017)

As shown from this conversation, teachers are making slight changes, or in Claire’s words, taking “small steps” in modifying their current assessments, but not to be considered three-dimensional. Rather than focusing on developing new three-dimensional assessments, they seek comfort in using assessments that are considered to be more traditional.

The descriptions of teacher’s assessment decision making, as a process of modifying pre-made traditional assessments rather than aligning to NGSS, uncovered the modifier-recycler assessment sub-identity. Modifiers-recyclers do not align their assessments to NGSS and lack knowledge of the three dimensions. They may feel a lack of power in their role as assessors and succumb to the external pressures of standardization.

A Process of Feeling: “I like this question!”

Another theme that emerged upon analysis of the teachers’ descriptions of their assessment decision making was a process of choosing questions that feel good and may at times be three-dimensional. Many teachers’ expressed making assessment decisions that felt right to them or aligned to their assessment beliefs rather than trying to develop three-dimensional
assessments. Although they are not creating three-dimensional assessments, they are seeking out questions that are three-dimensional. For instance, Samantha, a Chemistry teacher with 6 years experience, shared during a focus group with teachers from different course teams:

As I’ve been thrown into these different scenarios I’ve just modified based on what I feel. I’m not very good with the NGSS terms [the three dimensions]. I’m sure some of our short answers are three-dimensional at some point because we have lots of analyzing, predicting patterns...but as far as referring to the dimensions when making questions, not all the time. (Focus Group #4, April 24, 2017)

Samantha, relies more on finding questions that she feels make for a better assessment of her students learning of NGSS instruction. Samantha not only sees herself as a facilitator of NGSS but also an assessor of NGSS. In other words, she recognizes that her past traditional assessments need to change. Sue Ellen mentioned a similar process of thinking like an assessor rather than just a facilitator during an interview when she stated:

I just pick the questions I liked that were meeting what I had just taught... I would just look at the question and go, I like that question. Then it would end up on the test. (Interview #1, April 27, 2017)

In another interview a few weeks later, Sue Ellen re-emphasized her process of using her feelings in making her assessment decisions rather than being concerned for the standards.

Well it’s one of those things. I’ll look at a question and I’ll go that’s a good question and I’ll know it’s a good question. I know it’s a question that will be addressing something that I want them to be able to address as opposed to checking to make sure it’s written for the standard that I’m interested in. (Interview #3, May 12, 2017)

Although Sue Ellen is aware of NGSS and three-dimensional assessments, she does not always choose questions that are three-dimensional. Instead, Sue Ellen chooses questions that she feels assesses their learning but they may not always be three-dimensional in nature.
Sue Ellen and James, a chemistry and AP chemistry teacher with 18 years experience, discussed specifically on how they chose certain questions they liked from other sources in which they trusted:

Sue Ellen: They did this [NGSS writing committee] and they know what they are doing so I’m just going to let them do it and I’m going to pick the ones I like, so.

James: I would look at worksheets, change numbers and now I have a quiz, change them again and now I have a test (sounds of agreement from the group) ta..da..

Sue Ellen: You can do that. That’s nice! (Focus Group #4, April 24, 2017)

The dialogue above reveals how James and Sue Ellen chose questions that felt right to them from a trusted source, like the NGSS writing committee. Although James and Sue Ellen do not feel comfortable creating their own three-dimensional questions, they do choose them from more reliable sources.

Along with referring to a reliable sources for guidance in finding “good” test questions to include on an assessment, teachers’ who also teach AP courses gave similar responses of liking and choosing “AP style” questions. This sentiment is reiterated in the following statement during an interview with Sue Ellen:

Then we also tried to include more AP style questions which are more, they are much more like what is on the AP test…[pointing to a specific question on an assessment] I think that’s a really clever question. I really like the way it is written and it is multiple choice but it shows their misconceptions about how nerve impulses travel...That’s what I do is I look at the questions that I have that go along with the topic that we are on and I try to pick the best ones that I can find. Writing my own, I’ve never been good at it, so. (Interview #3, May 12, 2017)

Even though Sue Ellen teaches AP Biology, she revealed a fondness for choosing to use AP style questions in her assessments for non-AP courses. Sue Ellen also provided an AP Biology assessment for document review. Upon analysis, the AP questions are higher level critical questions rather than low level memorization questions. Those higher level questions are more
three-dimensional because they require students to use cross-cutting concepts to do a practice within a specific scientific context. It appears that AP style questions are more three-dimensional than traditional multiple choice questions. Although Sue Ellen is willing to try to include three-dimensional assessment questions, she does not feel confident enough in her ability to create them.

The descriptions of teacher’s assessment decision making, as a process of choosing assessment questions that they felt were good and at times were aligned to NGSS, uncovered the feeler-finder assessment sub-identity. Feelers-finders may at times align their assessments to NGSS and have some knowledge of the three dimensions. They may at times feel a lack of power in their role as assessors but view themselves as both a facilitator and an assessor. They are willing to tinker with their assessments to make them more three-dimensional.

A Process of Creating: “I’m trying to figure out how to do it”

The third theme that surfaced upon analysis of the high school science teachers’ descriptions of their assessment decision making was expressed as a process of creating and developing brand new assessments aligned to NGSS that are three-dimensional.

As mentioned previously, a large number of the teachers who participated in this study recounted experiences with modifying assessments rather than creating assessments that explicitly weave together the science and engineering practices, cross-cutting concepts, and disciplinary core ideas. Therefore, teachers spoke to experiences of creating new assessments as a challenge. One of the challenges was fully understanding what a three-dimensional assessment should look like. This was made evident in the conversation during the focus group with the Biology team who redesigned the whole Biology curriculum this year to be aligned with NGSS:
Ernest: I would even have to go online and read what is a good, what is considered a good model 3D assessment, what would it be? So, then I could be like okay, now I am in the mode and then…

Drea: Oh, yeah. We are all on the same page there with you.

Elizabeth: Yes. Yes.

Ernest: Because I feel floundering in the water with 3D assessment.

Elizabeth: 100%

Drea: Yes.

Mary Ann: Yeah

Ernest: No clue what they really want. What is a real 3D assessment? I don’t know? What does it have to have in it?

Elizabeth: Like, where do you start?

Drea: Uh...huh…

Mary Ann: I need training.

Elizabeth: Yeah. I agree.

Mary Ann: ...and NGSS too!

Drea: Some of the ones I’ve seen, I’ve struggled with seeing how it is a 3D assessment…

Elizabeth: Yeah.

Ernest: uh..huh…

Drea: ...and those are some of the things that have been put out by people that are writing for NGSS. (Focus Group #1, April 7, 2017)

Seen by other members of the department as more progressive, the Biology team re-designed the entire curriculum and thus created new assessments for the entire year from scratch. The dialogue above reveals the teachers’ struggle creating new assessments that were three-dimensional without having a clear explanation on the process of developing one. In Elizabeth’s
words, they are “floundering” while trying to figure out “what they really want.” In this context the “they” would be the authors of NGSS. The authors of NGSS consisted of K-12 teachers, state science and policy staff, higher education faculty, scientists, engineers, and business leaders. The federal government was not involved. Therefore, NGSS is a move away from standardization that requires teachers to create instruction and assessments. The dialogue continued to reveal that the development of those assessments were a struggle due to a lack of understanding on how to create a three-dimensional assessment.

Ernest: We write shit and we’re like okay, this seemed pretty good. I don’t know? Maybe? Then the kids kind of crash and burn and then we look online and find something we just did and we made it up and it is very similar to what we did for our unit or whatever.

Elizabeth: Yep.

Ernest: ...and we’re like, oh my god, that’s right? That’s supposedly right but we will need to change it, it didn’t work. So, that is the confusing part, the examples. Where’s the golden example?

Elizabeth: We are all floundering…” (Focus Group #1, April 7, 2017)

Again, Elizabeth uses the term “floundering.” This may be because NGSS moves away from the structures of standardization that teachers are working within. The process of teachers creating assessments goes against the social structures of standardized assessments that are used to measure the effectiveness of teachers. Even though there are these external social pressures, the Biology team is attempting to design their assessments to be more three-dimensional. However, it is evident from their dialogue in the focus group that they are floundering with how to develop them. They are seeking a “golden example” that shows them what a three-dimensional assessment should look like. Based on their social positioning in a less powerful figured world, the teachers feel compelled to look to those in more powerful social positions to tell them what
their assessment should look like. *NGSS* has given teachers the opportunity to have autonomy in writing their classroom assessments but teachers may not feel positioned to do so.

Esther, who is also a member of the Biology team, participated in a separate focus group and revealed a similar perspective of writing three-dimensional assessments along with other members of the science department:

Esther: ...I feel like there’s nobody who’s really like doing a true 3D assessment. I don’t know what a true 3D assessment looks like, right?...like, I have no idea how to even start one. I see examples [from Washington State] and I’m like that looks great, but what was your thought process behind it?

Claire: How did you come up with that?

Esther: Right. How did you, why did you format it this way? What kind of data do you need?

Claire: Did they make up their data or did they find it? Is it real data or is it not?

Esther: So, it’s like a lot. I have so many questions about the assessment and I don’t have anybody answering my questions. (Focus Group #3, April 13, 2017)

The conversation between Esther and Claire, as seen above, reveals some of the same concerns that were discussed in the Biology team focus group. It appears that teachers are attempting to develop three-dimensional assessments but lack the resources or “golden example” to be able to do so fully. Concerns for creating a new assessment were voiced when Claire stated, “How can we take a very simple old-fashioned question...and break it up into a more interactive, more *NGSS* thing?” (Interview #1, April 25, 2017) It appears that Claire may be open to creating new three-dimensional assessments but may be unaware or feel ill-equipped to do so. For instance, Claire is also questioning if the three-dimensional questions are using “real data” or not. Similar to Earnests’ comment about the “golden example,” this evidence shows that teachers are
questioning what a three-dimensional assessment should look like and are still functioning within a standardized model of assessment.

Many participants reported a lack of adequate resources and professional development necessary for them to create their own three-dimensional assessments. As stated from Emily, who is also an Honors Biology team member and Animal Behavior teacher with just three years of teaching experience, “I know I said this before, but I think there’s still so much we don’t know about 3D assessments” (Interview #2, May 11, 2017). Emily noted in a prior interview:

Even though I feel like I have a decent understanding of NGSS, and maybe it’s not the best, I feel like we need more about what a 3D assessment really is because I don’t know if that’s a 3D assessment? In my mind it is, but I haven’t seen one. I don’t know if anybody has seen one because people are still writing curriculum. (Interview #1, May 4, 2017)

Many of the teachers also discussed their concerns with taking on too much change and not having enough time in their day to create brand new assessments. For example, one teacher stated:

It comes at the bottom of the list of being able to make it through whatever it is for the week, the day, the month, or the school year which is horrible...I haven’t started to learn to do that myself either. So, part of it just, you know me, and the time to figure this all out because I am not trained necessarily in what they all mean but I’m trying. It all ties together but it is another facet on top of making a whole unit from scratch that is NGSS. By the time you get to the assessment, which should be made first, it’s exhausting. (Saylor, Interview #2, May 4, 2017)

As revealed in the passages above, teachers may not see themselves and both facilitators and assessors of learning. Not only do teachers have to change their instruction to align to NGSS but they are also now expected to create new three-dimensional assessments without having “seen one.”

Understanding some of the challenges with writing three-dimensional assessments from the ground up, a few of the teachers exposed some of their resources. Members of the Honors
Biology team revealed that one of their more recent assessments considered to be more three-dimensional was actually developed from an NGSS writing committee. When asked about the specific assessment in an interview, Sue Ellen hesitantly explained:

To be honest, we didn’t design it. What we did, and the last unit was, we piloted a unit that had already been written [by an NGSS writing committee]. We tweaked it along the way and the unit actually had an assessment that had already been written which we used. From what I gather tangentially, it was a 3D assessment. I don’t know if that’s true or not because I don’t really know what that means, but it was more performance-based than it was just multiple choice. (Interview #2, May 4, 2017)

As shown in the previous statement from Sue Ellen, members of the Honors Biology team struggled with creating new questions that were three-dimensional and instead relied on a three-dimensional assessment from an outside “credible” source. To use Sue Ellen’s term, the Biology team “tweaked” the assessment. So, although they sought out a three-dimensional assessment from a trusted source, they still could not resist tweaking the assessment.

In addition to teachers expressing reliance on pre-written NGSS assessments, a few teachers spoke about researching and trying to find three-dimensional assessment examples for affirmation and guidance. According to Emily, “…I Googled 3D assessments because I was like, I wonder if I really know what it is and I did. My thought of it was correct but I was not impressed with the resources that that even came up on Google” (Interview #2, May 11, 2017).

Although Emily was not impressed with the resources she found, she took initiative in seeking them out. Another teacher who recalled experiences of researching three-dimensional assessment examples was Drea. While explaining her decision-making process for a specific assessment, Drea, discussed how she used Google to find examples and stated:

Okay, so when I was trying to do this 3D assessment and I saw people [educator websites] that were like, if a name came up about NGSS or something because I think that’s what I put in the search engine was NGSS 3D assessment examples, I did look if a teacher's website came up. I did look at their website to see if there was like any activities
that I could see and how it was interpreting NGSS. I didn’t really find any 3D assessment information though, unfortunately. (Interview #2, May 3, 2017)

Similar to Emily’s experience using Google to find outside resources, Drea was unsuccessful finding examples to fit her needs but she took initiative in trying to find them. Drea also explained how she evaluated her resources to see “how it was interpreting NGSS.” This reveals that Drea may not trust these outside resources interpretations of three-dimensional assessments. Drea has a strong understanding of NGSS and recognizes how other teachers may misinterpret the standards or try to fit the standards into their past instruction rather than starting from scratch.

Despite expressing feelings of concern for the lack of resources, Drea admitted to, “trying to figure out how to do it” (Interview #2, May 3, 2017). Drea’s decision-making process to create her own three-dimensional assessments was evident in her thoughts during the think-aloud protocol. Drea revealed as she created the second semester Biology exam:

> We have implemented the NGSS practices and cross-cutting concepts in our classrooms this year so I spent a lot of time trying to research what was already out there and there’s not a lot out there. There’s hardly any examples of three-dimensional assessments so that was a little bit, a lot overwhelming, but figured you’re not going to be able to figure out how to do it unless you just sit down and try to figure out how to do it. (Interview #3, May 10, 2017)

Drea then continued to explain how she decided on how to make the questions on the exam three-dimensional by making sure that the science and engineering practices (SEPs), cross-cutting concepts (CCCs), and disciplinary core ideas (DCIs) were all woven together within a series of questions. Upon review of the final copy of the semester exam that Drea provided, it is evident that the questions are designed around scenarios that require students to identify patterns when analyzing data to show mastery of concepts covered during the semester. This is a three-dimensional assessment.
The descriptions of teacher’s assessment decision making, as a process of creating assessments aligned to NGSS, uncovered the creator assessment sub-identity. Creators may at align their assessments to NGSS and are highly knowledgeable of the three dimensions. They feel confident in their role as assessors and have a strong sense of power to move against the societal structures of standardization. They are willing to create new assessments to make them three-dimensional to assess three-dimensional learning.

The Assessment Decision-Making Process is Focused on What to Assess

The next key assertion apparent upon analysis of focus groups, interviews, think-alouds, and assessment artifacts was high school teachers’ descriptions of their assessment decision making were dominated by considerations for what to assess. Teachers discussed how their decision making in developing assessments was influenced by focusing on learning goals, concerns for incorporating the science and engineering practices along with content, and tensions with including cross-cutting concepts like patterns, and cause and effect.

Learning Goals: “It goes back to the objectives”

The everyday conversations in regard to learning goals materialized as one of the most influential reasons for their assessment decision making. According to Ernest, “We know we want to assess them on the goals” (Focus Group #1, April 7, 2017). Similarly, Elizabeth stated, “The learning goals tend to drive what we teach and what we assess...that is probably the biggest reason for why we ask certain questions on our assessments” (Focus Group #1, April 7, 2017). When Ernest, Elizabeth, and other members of the Biology team were asked about how they incorporate the disciplinary core ideas or key scientific content in their focus group, the
conversation came back to the learning goals. This is evident by the following dialogue during the Biology team focus group:

Elizabeth: It’s the meat of the assessment. I feel like we use the concepts from the disciplinary core ideas…

Drea: To make our goals.

Elizabeth: To make our goals, which leads to our curriculum, which then leads to how we are going to assess them…(Focus Group #1, April 7, 2017)

As seen in the conversation above, teacher-created learning goals which are focused only on content knowledge drive teachers’ decision making as to what appears on assessments. This may be why teachers have assessment questions that only address content or the disciplinary core ideas. The learning targets are not addressing the other two dimensions including the engineering practices or cross-cutting concepts.

In addition to the dialogue in the focus group with the Biology team, multiple teachers referenced learning goals, often referred to as objectives, when deciding on what should be included on an assessment. One representative statement comes from James, an Honors and AP Chemistry Teacher. During one of the focus groups James shared:

I think initially it starts with objectives. Whether created by course teams, or by national institutions, or college board, or what have you. Then it expands from that. I think it’s in some cases personal for teachers depending on how much or how little they want to assess the kids beyond that….but yeah, bare bones, collaboratively agreed upon objectives. (Focus Group #4, April 24, 2017)

The previous statement overwhelmingly shows that many of the high school science teachers who participated in this study frame their assessment decisions around the learning goals or objectives that they may or may not have designed.

Teachers also spoke specifically as to how they designed their daily learning targets from their objectives, which then influenced their decision making for what they included on their
assessments. As mentioned by Emily, “we have objectives and then we have daily learning targets” (Focus Group #4, April 24, 2017). Emily stated later on, “we’ve gotten really good at writing daily learning targets, which I feel have helped all of us teachers to see the storyline of the unit and I think ultimately helped our assessment decisions to be unanimous” (Interview #2, May 11, 2017). Many of the teachers voiced that they refer to agreed upon daily learning targets when modifying or creating assessments. According to Claire: “I think focusing on the learning targets your assessment should be assessing their understanding and mastery of those big learning targets, not some random off the mark fact” (Interview #1, April 25, 2017). Upon further dialogue during a follow up interview Claire explained:

> So, we’ve been more intentional about making assessment questions based on what we’ve done in lab, through activities and the main goals, or points, or objectives that we’ve been trying to hit. So, to add more questions that are addressing the major learning targets that we’ve been getting at. (Interview #1, April 25, 2017)

As shown in the passages above, the teachers intentionally refer to their learning targets when developing instruction and this should also be done when creating assessment questions.

Another teacher, Drea, spoke about a specific assessment and how she relied on the daily learning targets to create the assessment questions. The activities in class required students to use science and engineering practices, like engaging in arguments from evidence, because they were also explicitly stated in the daily learning targets. For example, Drea stated how they were focusing on having the students practice claim, evidence, reasoning, one of the science and engineering practices, while learning about group behavior in different animal species. Drea stated, “The evidence that they use to support whatever claim they are making is what they are coming to class with, it is the answer to the learning targets basically or the activities that they did” (Interview #1, April 26, 2017).
The daily learning targets, for some of the teachers interviewed, were explicitly provided to the students and then became the prompts on their assessments. While discussing learning targets during an interview, Ernest pointed to them on his whiteboard. He posts the learning target questions on his board for the students to see. As he pointed to the targets on the board Ernest said:

When we write a test...I like to go back to the goals and I would rather just do a practical application toward the goal. So, how does biodiversity impact us and what effect are humans having on biodiversity? Those are the two goals. Give them some data and tell them to apply what we’ve learned. (Interview #2, May 5, 2017)

Again, Ernest’s response reveals the tensions between the learning target goals and authentic three-dimensional assessments. Emily, who was on the Biology team last year, also referred to explicitly stating the learning targets while teaching Honors Biology and Animal Behavior.

So, in both classes we start with the objectives. I really try at some point to tell the students what the learning target is. They are always on the board but I try to connect them. Those are Bio and Animal’s are over there (points to them on the board) behind the board. I try to just for the sake of creating a storyline for the students because that’s what I go back to, to assess their understanding [on a test]. (Interview #1, May 4, 2017)

All the teachers who participated in this study shared how they referred to course objectives and daily learning targets when deciding on what questions to include on their assessments. Whether mentioned directly during a think-aloud, posted on the whiteboard in the classroom, written on the top of the assessment, or discussed during a focus group or interview, course objectives play a large role in teachers’ assessment decisions.

Although all of the teachers made reference to learning targets and objectives, they did so in varying degrees. This relates back to the three different types of assessment sub-identities that teachers may move in and out of. Modifiers-recyclers may tend to have learning targets that are used only during instruction. Feelers-finders may attempt to include learning targets when
making assessments and creators design both their instruction and assessments around their learning targets.

**Science and Engineering Practices (SEPs) vs. Content: “It is both, it is content and skill”**

Alongside conversations related to the learning objectives and learning targets, concerns for those learning targets to be focused on content or skill surfaced among the high school science teachers’ dialogue as another influence for their assessment decision making. As a reminder, a few examples of science and engineering practices include: asking questions and defining problems, developing models, planning and carrying out labs, and analyzing data. Some of the Biology teachers described in their focus group how they would like to assess students on learning targets that encompass both content and skills:

Elizabeth: This year’s been, I think, specifically difficult because the Bio team made a decision to revamp everything and so now we are struggling to find what content we are going to teach and if we all really want to teach skill. Then we decide on a skill but that leaves them, at least what I feel, leaves them at the end [of decision making]. I don’t even think about it. We are struggling so hard just to figure out what we are going to do day-to-day...

Drea: Yes

Elizabeth: What the content is…

Ernest: I think content is critical, I really do. It is both, it is content and skill. It is good that we do content and skill. (Focus Group #1, April 7, 2017)

In the same focus group shortly after the dialogue above, the teachers brought up their concerns with developing assessments that assess both content and skills. The teachers discussed:

Elizabeth: There’s all these thoughts that are being thrown around and it’s like okay, did we assess a skill? I don’t see it on the test (laughter from the group). That’s why I said in the beginning there’s a lot of regrets...(laughing)...you know? Ernest: I feel like we give the test and it’s like can we count this one [test question] as a skill? (laughter)
Elizabeth: A lot of question marks.

Mary Ann: Totally…

Elizabeth: We have in the past units, we have, umm...tried to select which SEP we’re going to focus on for the entire unit and there have been somewhere we’ve done some sort of pre-assessment of the skill like creating a model and see what kind of model they create. Then at the end on the assessment they have to generate some sort of model. So, I think we decide on the SEPs at the beginning of the unit ideally. Now, it hasn’t happened in the last couple of units like we’ve kind of fallen off…

Drea: Right.

Elizabeth: Like the skills that we want to focus on because we don’t have the...we’re scrambling for the content. So, I would say that would be probably the way that we’re working toward incorporating the SEPs into our assessments.

Mary Ann: In some ways we’ve done it, the one Elizabeth is talking about with photosynthesis, they drew a model of that and cellular respiration. Drew, just drew a picture and labeled it before and after. We’ve done, they designed their own photosynthesis lab, umm, or was that cellular respiration? Both?

Drea: Yeah, both...

Elizabeth: Well, we have no way of like, we really struggle with trying to figure out how we can incorporate some of those SEP’s into a paper and pencil test. (Focus Group #1, April 7, 2017)

As shown in the dialogue above with members of the Biology team, they consider content and SEPs to be included in the learning targets, which then drive what is assessed on their tests. As mentioned by Elizabeth, it worked best when learning targets were decided on prior to the beginning of a unit. The conversation also reveals that the teachers struggled with incorporating skills on assessments when they are not already included in the learning targets, or because they are considered to be difficult to assess on a paper pencil test. The assessment may need to be more performance-based and move away from the traditional multiple choice format that many teachers feel comfortable with.
Despite concerns for assessing skills as mentioned in the previous conversation, multiple teachers voiced their intentional considerations for including SEPs, or skills, along with content when making assessment decisions. One statement that supports this claim:

I mean yes, the physics matters because we’re in physics; however, that’s not always the point. It’s can you read this graph? Can you look and see what the trend is? Can you come up with relationships from what’s happening in a problem? I think that they can take those skills throughout a whole bunch of classes and you know your life in general. (Isla, Interview #2, April 11, 2017)

Although the teachers’ responses voiced their desires to explicitly assess skills, teachers also voiced concerns and their struggles with assessing skills. One concern was teachers feeling inadequately trained to write questions to assess skills as shown in the following statement:

What I know we should assess is what I am comfortable assessing and that’s content. What I know we should assess is what I’m not comfortable with because I don’t feel trained or sufficiently aware of how to teach and therefore assess and that would be skills. Because of my teaching, education, and how I wasn’t trained in that at all. So, of course, I’m not comfortable with it because I wasn't trained in it and how can I teach it when I don’t have the time to figure it out or the resources. So, I think that’s where, that’s where the tension comes from. (Claire, Focus Group #3, April 13, 2017)

In addition to the teachers in this study voicing concerns with assessing skills because of a lack of training, some of the teachers also discussed their lack of understanding of how NGSS calls for a shift in their teaching and assessment practices.

Sue Ellen: When I was first introduced to NGSS, I thought what’s the big deal. I always felt that way about standards. I always felt like if you are not meeting those standards you’re not doing your job, and the old Illinois standards there’s only like 3!

James: 11, 12, and 13…

Sue Ellen: 11, 12, and 13…It was like…

Claire: Oh! That’s right!

Sue Ellen: You know we do these and when I saw the NGSS standards I thought the same thing and I went through them and said, I do that. I do that. I do that. I do that. Then I heard someone talk about it and say it’s not about the content it’s about what they do
with the content. He says most people don’t even pay attention to those SEPs and CCCs and I went…(gave a look and chuckled)...

Claire: Oh the words!

James: (laughs)

Sue Ellen: And I went like, that’s me! I went back and looked at it again. It’s not about the content it’s about representing it, you know, with a model…

Claire: Analyze the data…(Focus Group #3, April 13, 2017)

As shown in the conversation above, it was transformational for Sue Ellen when she understood that what makes NGSS different from previous standards is that they are three-dimensional. This also meant her instruction and assessments should also be three-dimensional. At the end of the conversation, Sue Ellen and Claire were addressing how their students can present content through the use of an SEP. Sue Ellen and Claire revealed how they conceptualize weaving together content and skill when making assessment decisions but are still working towards putting those decisions in place.

Drea also spoke about how it took a transformational experience for her to shift her assessment decisions from only addressing content to including more skills. Drea stated:

I think I just had a “come to Jesus” moment, I guess. Where I thought to myself, would I rather them come in with the memorization of the stages of meiosis or whatever it is, or would I rather come in knowing how to figure something out because a lot of them are being spoon-fed knowledge or information that helps them to do really well on an exam but they are not putting it together in a story about what each unit has to do with the other. (Drea, Interview #1, April 26, 2017)

This shift in mindset to focus more on skills has also shifted her instruction to include less lecture even though other members of her team, such as Ernest, may disagree. According to Drea:
Sometimes people will, or person, will voice that they are not or they don’t think that a skill, skill development should come at the sacrifice for content. It might take some people a little bit longer to see the value to recognize or realize that the students get the content even though you are not lecturing. They’re still getting the same amount of content and sometimes even more. (Drea, Interview #2, May 3, 2017)

As heard in the passage above, Drea’s instruction has shifted and does not feel that content and skills should be taught separately. Students should be practicing engineering skills while acquiring content knowledge. Overall, through the experiences voiced by the high school science teachers in this study, the shift to NGSS has influenced their intentions to include skills when making assessment decisions. The teachers’ conversations on how to develop questions that address both content and skills are evidence of their explicit intentions. The teachers’ are also shifting their instruction to include more SEP’s to address content.

Tensions with Cross-cutting Concepts: “We’re almost 3D, we’re like 2.5D”

Finally, upon analysis of the teachers’ descriptions of their assessment decisions in considering what to assess, tensions emerged when discussing the incorporation of cross-cutting concepts. As a reminder, cross-cutting concepts (CCCs) include: patterns, cause and effect, scale, systems, etc. A couple of the teachers spoke about how they do not intentionally include cross-cutting concepts when developing assessments. One representative comment:

Well, we do have some of the scientific practices in here, which I think is a step in the right direction for us but this is not directly aligned with the performance expectation. So, without being aligned to a PE it is hard for us to identify the cross-cutting concepts...I know there are probably cross-cutting concepts and disciplinary core ideas in here but we were not cognizant of them when we designed it. We are having the students participate in some scientific skills but it is definitely not, not three-dimensional yet, or at least I don’t think so. (Emily, Interview #3, May 18, 2017)
As mentioned by Emily in the statements above, she is aware of the cross-cutting concepts but does not explicitly assess student’s mastery of them on their assessments. If so, it may be accidental. Similar comments were made during the following focus group conversation:

Esther: ...I think we are doing better with the SEP’s than we are with the cross-cutting concepts but I mean, it’s all connected right? So, a lot of times...the SEP which was obtaining and evaluating evidence...and then if you want to immerse that with patterns, well here’s the data, what patterns do you notice?...I feel like some of them we’re hitting but not intentionally. I would think we’re like maybe the patterns, yeah, and cause and effect, but everything else I don’t think is. We’re not like, okay, what’s our CCC for?

Claire: That’s what I was going to say. I was going to say that we probably have them some place but I wouldn’t say it’s our goal to set out to design a question that specifically addresses a cross-cutting concept.

Esther: Yeah.

George: Yeah. I think for me too, it’s more of a coincidence if we hit that or patterns. We don't do enough of that on tests, for sure. (Focus Group #3, April 13, 2017)

As discussed in the dialogue above, a few of the teachers felt that they were working on intentionally including SEP’s but were expressing tensions with also including CCC’s directly on their assessments. Students may unintentionally have to use a CCC to answer questions but the assessment is not directly assessing them on their mastery of a CCC.

Similarly, during an interview with Claire, she was asked how she included CCC’s into her assessments. Her immediate response was, “Oh, the CCC is cross-cutting concepts. I don’t remember what those are?” (Interview #2, April 28, 2017). When reminded what they were Claire responded with, “Oh, see that’s funny. I guess in my head I don’t realize that we are doing that all last chapter. That’s what we did was identifying patterns. It’s funny where I don’t realize what we are doing” (Interview #2, April 28, 2017).

Tensions with including CCC’s also emerged during the think-aloud. For instance, Cal expressed his frustrations during his third and final interview and stated, “I wasn’t sure when I
was doing my think-aloud where cross-cutting concepts…?” (Interview #3, May 16, 2017). Cal voiced that he had not thought about them nor fully remembered what they were. Similarly, Isla, who is also on the physics team with Cal, shared in her think-aloud that she included the cross-cutting concept graph interpretation; however, graph interpretation is not a cross-cutting concept. Isla seemed confused about what the cross-cutting concepts were as well.

Other participants revealed that they were unaware of the cross-cutting concepts or did not intend to include them on their assessments. For example, when the Physics team was asked to describe an assessment that they considered to be three-dimensional, the following dialogue developed:

Cal: I think to hit all three of them the commonality is going to be the engineering, probably because you've got to be designing something and so it makes me think it makes me tend toward the windmill project and the bridges and the mousetrap cars and things like that, where we are designing...to pick one, the windmill project I think...to me Newton’s third law sounds like a core idea to some extent and the design and evaluation process of actually building it...

Isla: ...and seeing how much energy produces it, how much voltage they can get from their windmill?

Cal: And what are the other parts? There’s the core idea...

Eli: Cross-cutting would be?

Cal: What’s the cross-cutting? (Focus Group #4, April 11, 2017)

The dialogue above discloses how members of the Physics team may be intentionally including science and engineering practices, but they may be unaware of the cross-cutting concepts the students should be using to complete the skill. Cross-cutting concepts (CCCs) may be viewed as a lens through with an engineering practice can be done. For example, students may need to recognize cause and effect, which is a cross-cutting concept, in order to analyze data. However,
the physics team is not assessing students on cause and effect. Additionally, when discussing CCC’s in another focus group the following conversation transpired:

Emily: I know we don’t, we don’t talk about it…

Sue Ellen: Never…

Emily: Never in planning have we ever once said, what’s the cross-cutting concept? Here on any of the teams that I’ve been on or that I’m on. But knowing what some of them are I’m sure I could tell you oh, yeah, we did this lesson one time that hit on this cross-cutting concept but that’s not actually like…(Focus Group #4, April 24, 2017)

As shown in the dialogue above, some of the teachers’ do not consider the cross-cutting concepts at all when making assessment decisions. They may be seen as implicit concepts and assume that the students already know how to complete them.

Teachers who created their own NGSS aligned assessments also spoke about tensions with including cross-cutting concepts. For example, during the conversation with the Biology team, Drea stated, “We’re almost 3D, we are like 2.5D” (Focus Group #1, April 7, 2017). When pressed further about that comment during an interview, Drea, explained how she didn’t feel that her assessments should be fully considered three-dimensional:

They might be assessing the skill and the performance expectation, but it is not necessarily highlighting the cross-cutting concept. Although they might be using that [cross-cutting concept], it is not being assessed, do you know what I mean? They might be looking at patterns and data, but it’s not specifically. Sometimes it’s accidental, you know what I mean? Like if we have a cross-cutting concept on one of our assessments it is not because we specifically sat down and tried to incorporate it, it’s a byproduct of what we are doing. I don’t even know that the samples that I see are really three-dimensional. (Interview #1, April 26, 2017)

In summary, teachers’ voiced uncertainty with knowing the cross-cutting concepts, concerns with intentionally including CCCs when making assessment decisions, and tensions with knowing how to incorporate CCCs in order to make the assessment three-dimensional.
In reference to the emergent assessment sub-identities, the modifiers-recyclers would tend to focus on content rather than skills. Feelers-finders may incorporate skills into their learning standards but only when they felt appropriate, while creators will create learning targets to address all three of the dimensions.

Teachers Negotiate Their Identity as Assessors Through Their Actions

Upon analysis of focus groups, interviews, think-alouds, and assessment artifacts; themes emerged and were then categorized underneath how teachers independently negotiate their identity as an assessor to not align, slightly align, or fully align with NGSS assessment practices. From the words of high school science teachers, they independently negotiated their assessment identity through their: a) use of NGSS language, and b) openness to change their assessments to be more three-dimensional.

Use of NGSS Language: “I’m like the guy who didn’t read the story”

The high school science teachers in this study utilized the language or multiple acronyms of NGSS in one of the following ways: not at all, slightly, or fluently. A couple of the teachers were unaware of the acronyms and did not use them during their conversations. This was evident when Sue Ellen responded, “Is it? Are we supposed to put the...objectives…? It is the only word I can think of because I don’t know the lingo” (Interview #3, May 12, 2017).

Confusion over the acronyms and terminology persisted during other conversations. When teachers were asked about disciplinary core ideas (DCIs) or content knowledge in the physics focus group, a few of them responded:

Cal: Again, I don’t think I know enough about that.
Eli: Yeah, I’m sorry… (Focus Group #2, April 11, 2017)

Even later on in the focus group when the physics teachers were asked to describe an assessment that would include the three dimensions the conversation began with the following dialogue:

Cal: This is going to be hard…

Eli: Yeah. So, core ideas, cross-cutting, is that right?

Cal: and engineering? (Focus Group #2, April 11, 2017)

The teachers were unclear of the three-dimensions and did not feel comfortable using the acronyms when discussing them. They also struggled to come up with an example of a three-dimensional assessment.

Frustrations over the use of acronyms became elevated during another focus group with a mixture of teachers from different collaboration teams. While one of the chemistry teachers was sharing his experiences, he used an NGSS acronym and the conversation went in a different direction:

Frederick: In chemistry we use a lot of for example modeling particle views, analyzing data, so I think so far we have a big grasp on the SEP’s, like…(laughter from more experienced teachers when the acronym was used) What? What?

Saylor: What the hell is an SEP? (laughter)

Claire: My question is what are they?

Saylor: I am so tired of those alphabet s***!

Claire: Just for the record, Claire doesn’t know what an SEP…

Frederick: Science and engineering prac (Frederick was cut off)…

Saylor: (laughs out loud)

Claire: No, I know, I know, I know what it stands for…

Frederick: I’m sorry
Claire: What are the science and engineering practices that I should be using?

Esther: I can pull them up…

Saylor: You are assuming that I know the science and engineering practices.

Frederick: Guy, guys…(he tried to calm everyone down)

Saylor: (talking to Esther who pulled out her computer) No, no, don’t.

Esther: Well, why not? How can you answer the question then?

Saylor: Everybody’s assuming that we all know.

Frederick: I’m sorry, yeah.

Saylor: and there’s these words…(laughter)

Frederick: It’s just skill right?

Claire: Because I’m jealous that you use it. It is so…in your language and I’m like, huh?

Saylor: Sorry, we digress.

Frederick: SEP’s is just like the skills. So, you have your content…

Saylor: Oh! It’s science and engineering practices, that’s what it means? (Laughs very loudly) (Focus Group #3, April 13, 2017)

A little bit further into the focus group Saylor revisited tensions with using NGSS acronyms and stated, “I guess, I’m thinking like you can tell who just came out of school…and…(laughter)...with some of these terms and that’s why I laugh, and I’m sorry, but…” (Focus Group #3, April 13, 2017). As mentioned in the dialogue above and all of the prior teachers’ statements; their voices uncovered that they do not use NGSS acronyms, they may be uncertain what they stand for, and a few of them were concerned that they may be judged by their colleagues for not using them.
Other teachers shared their frustrations with using acronyms and new NGSS terminology while sharing their experiences; however, they attempted to use them. One example of this was when Sue Ellen shared, “If you’ve got targeted performance ‘things’? I don’t know if that would be the PEs (performance expectations) or not?” (Interview #3, May 12, 2017). Although Sue Ellen felt uncertain, she referred to PE’s instead of using the word performance expectations.

Another example occurred when teachers in the Biology focus group were using acronyms during their dialogue, the following conversation took place:

Ernest: ...and when they speak like this I am like the guy who didn’t read the story... (laughter)...and I’m like, yeah, Jo in Little Women was a guy. (laughter)

Elizabeth: Jo was a female…

Ernest: DCI’s (disciplinary core ideas) love’em (laughs) (Focus Group #1, April 7, 2017)

The above conversation reveals that Ernest is unaware of what the acronyms stand for, rarely uses them, but then used an acronym to stay in that conversation.

Upon further pressing during an interview, Ernest shared his thoughts and reasoning for his slight use of NGSS acronyms. Ernest referred to the new terminology as a “power weapon” and also made comments like, “Don’t beat me with the terminology” (Interview #2, May 5, 2017). Further into the conversation Ernest revealed:

The other thing is that with scientists, lawyers, and doctors, this whole system, the whole new system all of this, the grading and NGSS stuff and the model and all that stuff is a new wave, A new vocabulary that I am not a part of and so I’m left out. The people that are really into that s*** like you, you learn it and you figure it out and you become a master of this terminology...and you can translate it for me. (Ernest, Interview #2, May 5, 2017)

Ernest expressed how he felt left out of the conversation because he was able to use the new vocabulary of NGSS; however, his response also suggests that he just needs someone to explain it to him. Then, shortly after Ernest stated, “If I knew what the fucking word was, I could explain
to you how I was doing it” (Interview #2, May 5, 2017). In other words, Ernest is suggesting that he does not need to use the terminology because he doesn’t need to. Ernest finally made clear that he has his own terminology when he stated, “Recall, application, and synthesis. I will always no matter what, it is what I am, that’s what I will call them” (Ernest, Interview #2, May 5, 2017), rather than using the new terminology of NGSS.

Although most of the teachers expressed tensions with using a new language or chose not to use them at all, a few of the teachers fluently used acronyms when discussing their assessment decisions. As well as teachers using acronyms like PEs, SEPs, CCCs, and DCIs; some of the participants, especially those on the Biology team, started to use language like NGSS-ing when referring to aligning with NGSS. For example, Esther stated, “We were NGSS-ing the entire year” (Focus Group #3, April 13, 2017), or when Ernest said, “We are doing NGSS, look at us we’re NGSS-ing” (Interview #1, April 28, 2017).

In reference to the emergent assessment sub-identities, modifiers-recyclers would refrain from using NGSS language. Feelers-finders may be aware of the language and can use certain terms to appear more knowledgeable but they do not know what they mean. For example, they may say they are NGSS-ing but they are not really. Creators are fluent in the NGSS language and fully understand what the terms mean and represent.

**Openness to Change: “That’s the hardest thing, being open to change”**

Teachers also spoke about the realities of changing their assessment practices to be more aligned to NGSS. Through their conversations about three-dimensional assessment decisions, teachers revealed how open they were to making changes in their assessments. Teachers’
perspectives ranged from not changing yet, beginning to change, and a few expressed fully embracing the change of NGSS.

Analysis of teachers’ conversations revealed that some teachers were not yet interested in taking the time to make changes to their assessments yet. This is evident in the following dialogue during one of the focus groups:

James: ...It’s hard to keep up to date on everything and it’s hard to streamline your content so that you can do an assessment like this because a knee jerk reaction is that it’s going to take time. It takes time to make. It takes time to do. It takes time to assess…

Samantha: ...and it’s hard to do when you don’t know what the end product is going to be…

James: And it’s hard to do. Yeah, and now I feel like the kids I was talking about a moment ago. Where, it’s hard to stretch. It’s hard to do something different with the risk of failing when you can sometimes do what you’re more familiar with and know it’s effective. (Focus Group #4, April 24, 2017)

As mentioned above by James and Samantha, time is a factor as well as fear of taking risks when they may not be confident that NGSS is more effective for students then what they are already doing.

Similarly, a couple of teachers explained that they would be open to changing practices if they felt that it was necessary. Cal explicitly stated he would, “change if there is reason to” (Interview #1 &2, May 8, 2017) when it comes to making three-dimensional assessments.

Although Isla shared in regard to her assessments that “There’s always room for improvement” (Interview #1, May 4, 2017) and also stated “I think everything changes, nothing is going to be static.” (Interview #3, May 22, 2017), she also expressed how she may not yet be ready to change her assessment decisions. This is evident in the following statement:
I’m open minded but to a point. If you can back up and explain why you are making the change you are, whether it is for the kids, or for the state standards, or for whatever we need to cover. I am all for it, but there’s got to be a legit reason for it. (Isla, Interview #3, May 22, 2017)

Teachers also made statements that uncovered their willingness to make slight changes to their assessments. One teacher revealed her openness to changing her assessment practices because of past positive experiences with including more assessment questions that assess science practices. Saylor stated:

I think we’ve changed a lot in Honors Bio to model and do the science practices. I mean, we’ve done that a ton in the last couple of years where they [the students] are engaged and they’re manipulating, looking at data, and they have to make connections. (Focus Group #3, April 13, 2017)

As shown in the statement above, Saylor has slowly changed some of her assessments and has seen positive results in her students learning. Those positive results may have also helped her to feel more comfortable with changing her assessment decisions in the future. Specifically, Saylor commented, “I feel more comfortable trying new things” (Interview #3, May 18, 2017). Saylor, later said, “I’m trying to be open-minded even though it’s hard to change” (Interview #3, May 18, 2017).

A few teachers expressed wanting to make some changes to their assessments because they felt pressures to do so. For instance, Frederick spoke about changing his chemistry assessments because changing the chemistry content to include NGSS DCIs would ultimately force him to change his assessment decisions. Frederick explained this pressure to change when he stated:

There’s a lot of things that we do cover content wise in chemistry that are no longer included in part of the NGSS disciplinary core ideas anymore...do we still keep teaching this or do we have to make a change here, right? (Focus Group #3, April 13, 2017)
Another teacher who expressed pressure to make changes was Claire. Originally, Claire shared that she was resistant to make changes in her assessment practices, and then later stated, “I’m embracing the change” (Interview #2, April 28, 2017). Claire later explained, “NGSS is really...a mandate. The reality is we have to and you have to buy-into it” (Interview #3, May 5, 2017). Therefore, Claire is making slight changes to her assessments because she feels pressure to align with NGSS.

Another reason that emerged as to why some of the teachers only slightly changed their assessment practices, even though they felt pressures to align with NGSS, was the concern that it was too much change at once. Teachers voiced their concerns with having to change their instruction as well as their assessments at the same time. Claire noted, “If you jump into NGSS, I can see how your assessments, they have to change...which is terrifying” (Interview #1, April 25, 2017). Ernest’s response in a separate interview reiterates this concern when he stated, “If we change how we do things, we should change how we assess” (Ernest, Interview #3, May 12, 2017). Ernest continued to say, “Too many people are ready to tear down the house…too much change in too little time” (Interview #3, May 12, 2017). Saylor also expressed her concerns for not aligning completely with NGSS due to not being able to catch up with all of the new changes.

Teachers who revealed that they were making slight changes in their practices also made comments about their evolving assessment philosophy. According to Claire, “I have definitely changed to more towards what are you [the students] going to do with the material (Interview #1, April 25, 2017). This comment is much more aligned to the NGSS framework. Another teacher, after using an NGSS unit and pre-written assessment from an NGSS writing committee, Saylor stated how the experience of changing what was typically done also changed her as an assessor.
“Honestly, it was a really good unit that I learned a lot about myself from” (Interview #2, May 4, 2017). For example, in her final interview, Saylor stated:

I never would have thought I would be making my decision making about these types of 3D assessments as a new teacher...I hope I keep changing the way I assess because that means I am still learning. I hope I don’t stop learning and trying new things (Interview #3, May 18, 2017)

Saylor’s decision to include more science practices was evident during Saylor’s think-aloud, while developing a Microbiology test about food poisoning. She spent most of her time finding data for the students to use in order to apply their knowledge of food-borne pathogens. Saylor explained, “I spent time finding data and I found a graph from a single outbreak in a university campus in Texas. So, they can see that on day 10-12 the outbreak occurred. Why on that day?” (Interview #3, May 18, 2017). Although the assessment was not three-dimensional, Saylor was working on including the science and engineering practices into her assessment decisions.

Lastly, one teacher provided statements during her interviews that revealed her reasoning behind her full alignment for making assessments three-dimensional. Drea’s statement below uncovers her openness to change her practices to become more three-dimensional.

I think you have to be in the right environment. I think that you have to not only trust your team but also your evaluator. That is you make a mistake that’s not really the biggest deal. Maybe that you took the chance to do something is more meaningful than the mistake. (Interview #3, May 10, 2017)

As mentioned in the statement above, Drea finds value in taking risks for the benefit of student learning. She is also willing to be seen as vulnerable to her evaluator, someone who is in a higher position of power, in order to do what is best for students. In a way, Drea views her risk taking and openness to change “in the right environment” as characteristics that place her in a higher power position. In this sense, Drea is considered a creator who embraces change and is willing to take risks. Modifiers-recyclers are fearful of change and prefer to continue what is considered
socially acceptable. Feelers-finders may be more open to trying something new but do not dive all the way in like creators do.

Teachers Negotiate Their Identity as Assessors Through Collaborative Relationships

Upon analysis of high school science teachers’ statements during focus groups, interviews, think-alouds, and through assessment artifact analysis; two super-ordinate themes emerged and were categorized underneath teachers’ collaborative ability to negotiate their assessment identity to either not align, slightly align, or fully align with NGSS assessment practices. Teachers collaboratively negotiate their assessment identity through: a) their roles in a collaboration team, and b) from colleague support in the department.

Teachers’ Roles in Teams: “I feel like we all do have our own little roles”

Through the words of high school teachers in this study, teachers collaboratively negotiate their alignment to NGSS based on their roles in their collaboration teams. Teachers who are on multiple collaboration teams expressed how their roles may be different depending on the team. Elizabeth, who has also been a member of multiple teams, stated:

I feel like my persona of what type of assessment I create changes every year, every team (laughter), every unit, like, I am, I feel like, just the way the school moves you around, you’re a chameleon. You have to move on to another team, another course, and you have to figure out a way to work with that new team to come up with what role you’re going to play in the team, and what role you’re going to play in making assessments. (Focus Group #1, April 7, 2017)

This claim is evident in the following dialogue during another focus group:

Esther: Oh, I just think my role in decision making, for example, in the Biology team, it’s a bigger team so I take a step back a little bit and I kind of listen more...If I feel like we are going in the wrong direction then I’ll steer us back.

Saylor: You’re more of a leader in the smaller one?
Esther: Yeah. Then with KI Bio I’m like the pseudo-leader. I have more of a voice and it’s like, hey let’s do this. (Focus Group #3, April 13, 2017)

As mentioned in the conversation above, it is clear that Esther adjusts her role as a leader depending on what team she feels that she has more voice in. She appears to have a greater voice in a smaller team where she feels more valued.

George spoke to the importance of having a voice on the team to be considered a leader in order to make changes in assessment decision making. George explained, “I would just say it would be very hard for me to get some of my team members to buy-in to this type of assessment. That would be one of my big hurdles” (Focus Group #3, April 13, 2017).

Another teacher, Emily, was a member of the Biology team last year, and is now in another collaboration team, also spoke about adjusting to a different role when making assessment decisions. In her role as the new member of the team, Emily sacrifices her full alignment with NGSS in order to work collaboratively as a team. This is evident in the following statement:

Like if I said, okay, instead of doing this multiple choice test why don’t we do this kind of test, you know? They would be like, are you crazy? It is a lot of work. I think it would be worth it in the end but I know that would be a big turn-off to a lot of people. (Interview #3, May 18, 2017)

Emily is aware of her positioning in her team and how certain assessment decisions are perceived. As a new member of the team, Emily went on to say, “If my team thinks that this is an important concept, then that might influence the way that I feel about the concept, too. If I was doing it myself, I might not pick those things” (Interview #3, May 18, 2017). This statement overwhelmingly shows how collaboration may influence teachers’ assessment decisions. Emily was not alone; other teachers expressed concerns about holding back in their collaboration team in their role as the new teacher on the team. This is apparent in the following statement:
According to Frederick in the passage above, being the new member on a collaboration team can be scary and intimidating. However, he also is recognizing the importance of each team member’s contribution when making assessment decisions.

Along with taking on the role of new teacher, a few teachers also spoke about their role in making decisions on their collaboration team as the experienced teacher. This is evident in the following statement, “As an experienced teacher, I kind of feel like I hold to my guns a little bit more then I would have when I was an earlier teacher” (Isla, Interview #3, May 22, 2017). Therefore, Isla’s role as the more experienced teacher will influence her decision making on the team.

Ernest identified himself as the experienced teacher in his team or the “old guy”, as shown in the following dialogue:

My identity as an assessor is I’m the old guy. I’m the old guy that went through the old stuff and I saw a lot that was good and a lot of it worked and all the new isn’t best because it’s new so I’m trying to be like a buffer between the new emperor has new clothes and all that stuff is good and nothing else before it has been good to hang on a lot of stuff we’ve done has been good and we need to incorporate it. I feel like I want to try to be little voice of that. (Focus Group #1, April 7, 2017)

In a later interview, Ernest went on to provide his perspective as the more experienced teacher in making assessment decisions in his collaboration team.

I have very little say for the years that I have been teaching. Not that how long you’ve been teaching can translate in any way to how good of a teacher you are, but I would say my level of at least wisdom of seeing what helps kids and bounces off of them and what soaks in them. (Interview #1, April 28, 2017)
Although Ernest sees himself in the role of experienced teacher, he does not perceive that his team members see him in that role when it comes to making assessment decisions in regard to NGSS.

Similar to Ernest, a few other teachers shared their perspective of their role in their collaboration team. For example, Claire stated, “I am really great at organizing things...If everybody was good at one thing you wouldn’t go anywhere...I feel like I don’t have to figure it all out” (Interview #2, April 28, 2017). Isla shared her perception of herself as the leader when she stated, “I take the lead on a lot of it because I want it to be done the right way” (Interview #3, May 22, 2017), and Cal revealed his perception of his role as, “I am more of the like when it [the assessment] is made...I more of like try to refine something that is already there or reword a question here if I feel like it is going to cause the kids to become confused” (Interview #2, May 8, 2017).

Not only did the teachers’ responses reveal that they assign roles to themselves in their teams when making decisions, but the responses also uncovered that they assigned roles to the other members of their team, as well. Sue Ellen shared the roles she assigned to her colleagues in the Honors Biology team:

> It’s nice to work with people who have their own strengths. So, Claire is the organizer, She is very, very good at organizing. I think that Emily is very, very creative in lesson design. It is natural for her and she is the NGSS go-to person...I would say that I would probably have more content knowledge. (Interview #1, April 27, 2017)

As shown in the statement above, Sue Ellen views herself as the content person in her team while she views Emily as someone more knowledgeable of NGSS. Although teachers addressed specific self-assigned or assigned roles within a collaboration team, many teachers also made comments about the importance of having many different teacher roles within a team. According
to Isla, “We all have our different ways of approaching stuff” (Focus Group #2, April 11, 2017). Claire described an ideal team when she stated, “I think the best group [collaboration team] is one that has different people that are good at many different aspects...to be responsible with what their giftings are...you have to have a trustworthy team” (Interview #1, April 25, 2017).

Although having different roles may be beneficial, a few teachers voiced their concerns with having to make assessment decisions as a team. For example, while Drea shared about the Biology team she mentioned, “We have a big team so some of the time is spent just agreeing on the data or even agreeing that we are going to use data” (Interview #1, April 26, 2017). She continued to say a team, “Needs members to be “open-minded about other people’s ideas...be flexible and try it” (Interview #1, April 26, 2017). Esther, another member of the Biology team stated, “I think it’s easier to change yourself as an assessor, like think of yourself as a...if everybody on the PLC is also down for it” (Focus Group #3, April 13, 2017). As Claire said to Esther in one of the focus groups, “You have to be willing to sacrifice yourself and a little bit of your personal self, in order for the greater cause” (Focus Group #3, April 13, 2017). Although Biology teachers’ expressed having different roles within the Biology team and voiced their struggles with making decisions, the Biology team overall is moving toward full alignment with NGSS. According to Drea:

I think for the most part the collaboration team is pretty close to the same page, especially towards 3D assessment. I think that most of the team may not have started out the year super on board NGSS-ing the entire year...but I think as we’ve been moving through it it’s kind of hard for them to go back to the old way. (Interview #2, May 3, 2017)

As discussed in the statement above, Drea views the Biology team to be very well aligned to NGSS. Using Drea’s terminology, the Biology team was “NGSS-ing” the entire year and would now have a difficult time reverting back to more traditional assessments. Therefore, as a member
of the Biology team, it is expected that assessment decisions will be aligned to NGSS. However, as a member of a different team this may not be the case.

**Colleague Support: “NGSS guy”**

The last theme that emerged through the voices of high school teachers in this study is that many of the teachers’ collaboratively negotiate their alignment to NGSS through the support of their colleagues. Throughout the study, teachers spoke about receiving support from other collaboration teams, from colleagues in their department, and from colleagues outside of the school.

A few teachers, who were not members of the Biology team, revealed through their commentary how they observe the actions of the Biology team in regard to their assessment decisions. Many teachers in the study commented on how they perceived the Biology team to be the most aligned team to NGSS and would refer to them during their conversations. For example, when George was discussing his assessment decision-making process, he stated:

> In Chemistry and Physics, we really should be having that piece of paper [that lists the dimensions] to look at. We hardly ever do. I’ve only done just on the outside at you know a conference or something like that. But, I notice the Bio team has got the sheet right there and they’re looking at it. (Focus Group #3, April 13, 2017)

Although George is not a member of the Biology team, he does happen to have the same period off as the Biology team and may often hear their conversations in the science department. Even though George may not be a participant in those Biology team meetings, he is an observer of their assessment decision making. As mentioned in his statement, because George witnessed the Biology team referring to the three dimensions (SEPs, CCCs, DCIs) when creating an assessment, he questioned whether that should be done in his collaboration team meetings.
Claire also referred to the Biology team when discussing the idea of changing her assessment practices to be more three-dimensional. Claire stated:

Students are still doing well on assessments [in general Biology], who have done this [NGSS] a lot longer than us and they still have good tests that they’ve made, and bad tests that they have made but the students are still being challenged in a good way and figuring it out. (Interview #2, April 28, 2017)

As Claire revealed in the statement above, she is aware of what the Biology team is doing by listening in on their conversations in the science department. Claire is also aware that the Biology teachers’ speak about how the students are still successful after changing their assessment practices to be more three-dimensional. Claire takes comfort in knowing that the students and the teachers are figuring it out and has mentioned how she refers to the Biology team with questions about NGSS because they are “NGSS-ing.”

As well as teachers who voiced how they looked to the Biology collaboration team for support, a couple of teachers also mentioned supports that they have received from other colleagues and collaboration teams in the department. Saylor commented a few times how she seeks help, “accessing people in the department that are even more knowledgeable than I” (Interview #3, May 18, 2017). This claim is evident in the following statement:

I hear a lot of other conversations in other [teams] throughout the department, like about how they are trying different things and how they are getting different types of feedback. It is outside of the way I have been thinking and I appreciate listening to others conversations about trying new things and getting more information back then just a typical old style assessment. (Saylor, Interview #3, May 18, 2017)

As shown in the comment above, Saylor is listening to the conversations in other course teams and is interested to hear about the different types of feedback that other types of assessments may offer.
Another teacher, Drea, also spoke about the collaborative support she gained from the other members of the science department. Drea revealed that if it were not for the collaborative nature of the department, she may not have changed her assessment decision making. This is evident in the following statement:

I think the culture of the department is pretty collaborative...I don’t think if I was in an environment like this, If I was not in this environment that I would have adapted to this change to NGSS and 3D, I don’t know? I think that we’ve had a lot of conversations that I may not have had in other environments that I’ve been. (Drea, Interview #3, May 10, 2017)

Drea’s comment above amplifies the importance of a collaborative culture. She recognizes that if she were not in that culture she may not have been as open to NGSS. If Drea were to have remained in isolation and been handed assessments to give, she may not be known as the creator of three-dimensional assessments in the biology team.

Finally, teachers commented about supports that they received from outside the school building when making assessment decisions. Drea stated: “There has been a shift in all of us since the introduction of NGSS and that first conference we went to” (Interview #3, April 26, 2017). The NGSS conference provided extra support for Drea and her team members to make changes in the Biology team. Ernest, another member of the Biology team commented, “We need to see what other people are doing so we feel so much better about what we do” (Focus Group #1, April 7, 2017). For Ernest, he would like to seek support from colleagues outside of the department to gain a different perspective.

For instance, Sue Ellen felt more comfortable about NGSS after collaborating with teachers from local districts on the writing committee. “Now we are branching out to write other units” (Interview #3, May 12, 2017). Later on Sue Ellen stated, “I’m telling you, being on this writing committee, that’s what did it for me because collaborating with these other teachers who
are all soul searching and trying to figure this out, putting their heads together with someone who has been through the training and knows what it should look like has been a huge help” (Interview #3, May 12, 2017). Sue Ellen earlier referred to one of the members of the NGSS writing committee and stated, “I have a friend who is very, very...he’s a big NGSS guy” (Interview #1, April 27, 2017). She later revealed that it was her friend who was the leader of the committee. This committee provided Sue Ellen with outside supports that she was not able to receive in her department.

Conclusion

In this chapter, four key assertions were discussed that emerged from the data collected during focus groups, interviews, think-alouds, and analysis of assessment artifacts. The four key assertions that emerged upon analysis of the data included:

- Assessment decision making is a process of modifying, feeling, or creating.
- The assessment decision-making process is focused on what to assess.
- Teachers’ negotiate their identity as assessors through their actions.
- Teachers’ negotiate their identity as assessors through collaborative relationships.

The first two key assertions address the first research question regarding teachers’ descriptions of their processes in making three-dimensional assessment decisions. The last two key assertions address the second research question as to how teachers negotiate their identity as an assessor both individually and collaboratively. Upon analysis, three assessment sub-identities, modifiers-recyclers, feelers-finders, and creators, emerged, which teachers may move fluidly in and out. The next chapter will provide a summary of the key assertions, a discussion of the three
assessment sub-identities that emerged in connection to the literature from Chapter 2, implications of the findings, and recommendations for various stakeholders.
CHAPTER 5

DISCUSSION OF FINDINGS AND CONCLUSION

The purpose of this study is to examine high school science teachers’ perspectives on their decision making in developing three-dimensional assessments aligned to NGSS, through a Sociocultural Identity Theory lens. Over the course of the study, the following research questions were addressed and key assertions emerged:

1. How do high school science teachers describe their processes of decision making in the development and use of three-dimensional assessments?
   - Key Assertion #1: Assessment decision making is a process of modifying, feeling, or creating.
   - Key Assertion #2: The assessment decision-making process is focused on what to assess.

2. How do high school science teachers negotiate their identities as assessors, individually and collaboratively, in designing three-dimensional assessments?
   - Key Assertion #3: Teachers negotiate their identity as assessors through their actions.
   - Key Assertion #4: Teachers negotiate their identity as assessors through collaborative relationships.

Utilizing a phenomenological approach, 19 high school science teachers within the science department at Cottage Hill High School participated in one of four focus groups. Upon
completion of the focus groups, eight of the teachers participated in a series of three interviews. Of those eight teachers, seven of them completed three separate interviews and one of them chose to combine interview one and two into one session. All eight of the interview participants completed the think-aloud protocol before their final interview. Throughout the study, assessment artifacts were collected from the teachers in the department.

Summary of Findings: Four Key Assertions

Rather than developing three-dimensional assessments, eight of the high school science teachers in this study described their assessment decision making as a process of modifying and recycling previously written assessments. These teachers spoke about relying on test banks for assessment questions, having little experience creating their own assessments, taking comfort in using past assessments as a starting point, and not attempting to align with NGSS three-dimensional assessments yet.

In addition, nine of the high school science teachers described their assessment decision-making process as one that relied on their feelings of what a good question looks like. Some of the teachers expressed choosing pre-written questions that they found and liked because it was something they covered in class or because it is what they considered as an AP-style question. A few of the teachers spoke about choosing to use an assessment written by an NGSS writing committee because they felt it was the best option. They made decisions that felt right to them rather than consciously aligning to NGSS.

The last category of high school science teachers’ assessment decision making was characterized as a process of creating new three-dimensional assessments. Only two teachers spoke about creating new three-dimensional questions for their assessments. These teachers
voiced making assessment decisions that more closely aligned with NGSS. They also shared their experiences of learning more about three-dimensional assessments in order to develop new assessments. Overall, the majority of teachers expressed concerns for the lack of assessment examples, resources, time, and training.

The second key assertion also addressed the first research question in relation to teachers’ descriptions of their assessment decision-making process. All of the 19 high school science teachers in this study mentioned their reliance on learning objectives and daily learning targets when making assessment decisions.

Although all of the teachers divulged their dependence on the learning objectives when making assessment decisions, the full inclusion of disciplinary core ideas (DCIs), science and engineering practices (SEPs), and cross-cutting concepts (CCCs) in those learning objectives varied across the teachers. Some teachers expressed comfort in assessing content over skills, while others have become more intentional to include both content and skills when making assessment decisions. Some teachers expressed concerns that they were not trained on how to assess skills in the classroom and did not have the time or resources to figure it out on their own. All of the teachers interviewed shared concerns with incorporating the CCCs when making assessment decisions. Even teachers who were seeking support in developing three-dimensional assessments expressed tensions with including CCCs on their assessments. Teachers shared that they were not aware of the CCCs, knew of them but did not consider them when making assessments, felt as if they were already doing them implicitly, or felt that they needed to explicitly include CCC assessment questions to assess students’ learning of them.

The third and fourth key assertions were categorized underneath the second research question. The third key assertion addressed teachers’ individual use of NGSS language. Teachers
shared concerns for their lack of use of NGSS terminology for fear of judgment or feelings that they were left out of the conversation. Individual teachers’ discussed making assessment decisions aligned to NGSS through their openness to change, but some teachers shared concerns about a lack of confidence in the development of new three-dimensional assessments, while a couple of teachers expressed that they fully embraced the paradigm shift of NGSS.

The fourth and final key assertion revealed teachers collaboratively negotiate their identities as assessors through their roles in collaboration teams as well as through support from colleagues within and outside of the science department. Teachers discussed roles that they were assigned or roles they assigned to others in their collaboration team. Some of those roles included the leader, the new teacher, and the experienced teacher. A few teachers also spoke about how their role in the team influenced their assessment decision making. For instance, teachers described sacrificing their alignment with NGSS for the benefit of the team they were on as well as holding back in discussion due to lack of experience. In addition to relying on teachers’ roles within their teams, teachers also sought support from the Biology team, NGSS writing committees, professional conferences, and professional learning networks.

Discussion of Findings: Three Emergent Teacher Sub-Idsentities

For the purpose of this discussion, the four key assertions summarized in the last section were further synthesized into three emergent assessment sub-identities (modifiers-recyclers, feelers-finders, and creators) directly related to the two research questions. Findings are connected to the literature and Socio-cultural Identity Theory discussed in Chapter 2. The following sections provide information to explain the three emergent sub-identities and their connection to the literature.
Teacher Assessment Sub-Identities

Upon analysis of the data through the lens of the Socio-cultural Identity Theory (Holland, Lachicotte, Skinner, & Cain, 1998) and conceptualization of Teacher Assessment Identity (Beijaard, Meijer, & Verloop, 2004; Ecclestone & Pryor, 2003; Looney, Cumming, van Der Kleij, & Harris, 2017; Pryor & Crossouard, 2010; Xu & Brown, 2016), three teacher assessment sub-identities (modifiers-recyclers, feelers-finders, and creators) materialized, similar to groupings identified in other identity research studies (Bower, 2012; Daghan & Akkoyunlu, 2014; Freedman & Appleman, 2008; Kawasaki, 2015; Sloan, 2006). Specifically, in the study by Kawasaki (2015), three identity groups emerged that expressed either very little, moderate, or high alignment to NGSS. The teachers rejected, negotiated, or accepted the identity offered to them as teachers of NGSS. Similarly, in the findings from an empirical study by Daghan and Akkoyunlu (2014), teachers rejected, negotiated, or accepted alignment to specific assessment frameworks due to their internalization of the framework. Through the voices of high school science teachers in this study, teachers expressed rejecting (modifiers-recyclers), negotiating (feelers-finders), or accepting (creators) their role as assessors of three-dimensional learning and making assessment decisions aligned to NGSS.

The three assessment sub-identities, which teachers may move in and out of (Pryor & Crossouard, 2010) and where one sub-identity may not rely on another (Hokka, Etelapelto, Rasku-Puttonen, 2012), may be dependent on teachers’: a) feelings of their alignment to NGSS, b) knowledge and skills incorporating DCI’s, SEP’s, and CCC’s in developing three-dimensional assessments, c) roles within their collaboration team, and d) relationships and support from colleagues both within and outside of the district. The three sub-identities will be discussed according to those four themes as well as the four dimensions of the Socio-cultural Identity
Theory including: a) figured worlds, b) positionality, c) space of authoring, and d) making worlds.

Sub-Identity #1: The Modifier-Recycler

Many high school science teachers in the socially-constructed figured world of teaching were modifiers-recyclers. Within the figured world of teaching, as suggested by Pennington (2007) and Thomas (2005), teachers are placed well below the figured world of policymakers, meaning teachers cannot teach or assess without input from them. Evidence of the modifiers-recyclers’ reliance on more powerful figured worlds when making assessment decisions are found in quotes such as, “Tests were given to me to use” (Sue Ellen, Interview #1, April 27, 2017), and “We had test companies come in and write tests” (Drea, Interview #1, April 26, 2017). Modifiers-recyclers feel a lack of power in their roles as assessors which may influence their lack of assessment decision making. As Pryor and Crossouard (2010) and Ecclestone and Pryor (2003) suggested, teachers may move in and out of their role as an assessor, or critic of learning; and facilitator, or supporter of learning. The modifier-recycler may view themselves as more of a facilitator than an assessor. For instance, teachers in this study made comments revealing their limited view of themselves as assessors. Some of those comments included, “If I developed anything, it was more like modifying” (Saylor, Interview #1, April 27, 2017) and “There isn’t much of a thought process” (Claire, Focus Group #3, April 13, 2017). As mentioned in the last quote, modifiers-recyclers may not put much thought into their assessment decisions or realize why they are making those decisions, which is similar to McMillan’s (2003) finding which suggested that teachers may not be aware why they make their decisions.
Positioned in the figured world of teaching as more of facilitators than assessors, the modifiers-recyclers reject alignment to NGSS and do not make three-dimensional assessment decisions. The lack of alignment may be due to a lack of confidence in the minimal role as assessors. Confidence was also a key dimension of teacher assessment identity in the study by Looney, Cumming, van Der Kleij, and Harris (2017). For example, a lack of confidence in making assessment decisions was evident in comments such as, “I try to refine something that is already there” (Cal, Interview #1 & 2, May 8, 2017) and “I don’t intentionally try to [refer to the three dimensions]” (Saylor, Think-aloud, May 18, 2017). Although they are making decisions to modify assessment questions, modifiers-recyclers do not intentionally seek to re-design assessments to make them three-dimensional. A lack of confidence in their role as an assessor may be one of the reasons why modifiers-recyclers resist changing their assessments to be more three-dimensional.

The modifiers-recyclers also expressed comfort in the process of modifying previously written assessments because they have not fully internalized the new framework of three-dimensional assessments. Along with a lack of confidence and lack of positioning as assessors, modifiers-recyclers may not have thought about or fully conceptualized the paradigm shift of NGSS and three-dimensional assessments. They may not realize what a three-dimensional assessment looks like compared to traditional assessments. For example, one teacher commented, “I think that’s kind of what we are doing” (Cal, Interview #1 & 2, May 8, 2017). This teacher was not weaving together the three dimensions when making assessments. He may have incorporated SEP’s but that is not considered three-dimensional. Another example of a teacher who may be resisting the internalization of NGSS was when Isla explained how her short answer questions have been modified to include more questions on labs. Although the questions
incorporated SEP’s and DCI’s, they were not three-dimensional. It did not require students to use CCC’s to answer the questions. Teachers may also be bringing in SEP’s in class instruction, but SEP’s were not on the assessment. This is similar to a finding of Daghan and Akkoyunlu’s (2014) where the teachers did not fully internalize the new evaluation philosophy and struggled to give up traditional habits. They could not internalize assessments as a performance task approach. If teachers in Daghan and Akkoyunlu’s study struggled to internalize a performance task approach, it may also mean that teachers will also struggle to internalize three-dimensional assessments, which are structured around performance tasks.

One possible reason for the modifiers-recyclers’ lack of internalization of NGSS may be attributable to their lack of three-dimensional assessment knowledge and skills. This lack of assessment knowledge was evident in comments like, “I don’t specifically know those three design dimensions” (Saylor, Interview #2, May 4, 2017), and “I haven’t read through them enough to know exactly what they are…” (Cal, Interview #1 & 2, May 8, 2017). According to Stiggins (1995), teachers tend to lack assessment literacy. This may be why modifiers-recyclers would prefer and feel more comfortable modifying assessments because they do not know how to write an assessment. It may be easier to avoid learning the three dimensions and continue to slightly modify assessments than to learn the dimensions and then have to write new assessments without having assessment literacy. Similar to findings from DeLuca and Bellara (2013), Moss (2013), and Webster (2011), teachers have very little training in assessment practices and are less likely to attempt alternative methods. This would be especially apparent with three-dimensional assessments because there are few examples as to what it looks like as well as how to write one.

Modifiers-recyclers also tend to assess learning goals focused on content objectives because of familiarity, comfort, and knowledge of content rather than the other two dimensions.
This is evident in one teacher’s comment, “I am comfortable assessing content” (Claire, Focus Group #3, April 13, 2017). She may not feel comfortable assessing science and engineering practices and cross-cutting concepts because she also stated how she doesn’t know them, doesn’t feel adequately trained, and doesn’t have the time or resources to figure it out on her own. This is similar to the findings from the study by Izci and Siegel (2015) who studied a chemistry teacher who did not use appropriate tasks to support her assessment construct of “doing” science because of time and content knowledge.

Lack of time and resources to gain knowledge of three-dimensional assessments may also mean that modifiers-recyclers are left unfamiliar with the terminology of NGSS. For example, one teacher stated, “I don’t know the lingo” (Sue Ellen, Interview #3, May 12, 2017). Because modifiers-recyclers are unfamiliar with the terminology they do not use the acronyms (SEP’s, DCI’s, CCC’s, PE’s, etc) or “lingo” of NGSS. Without using the language of NGSS, modifiers-recyclers are not invited into the figured world of NGSS and three-dimensional assessors. They may not even be aware of such a world.

According to Holland, Lachicotte, Skinner, and Cain (1998), people placed in figured worlds are limited by the degrees of acceptance and negotiation of identities offered; however, through semiotic mediation people may have some control over their positioning. Teachers’ use of NGSS terminology is a mediating device in the socially-constructed figured world of NGSS assessors and the creator sub-identity. The lingo of NGSS is a system of meaning for the teachers within that figured world. Modifiers-recyclers are placed outside of the NGSS assessor-figured world by refraining from or having unfamiliarity with the spoken language; however, they may be offered positions when they re-author or change their script by using the language or crafting new responses (Holland et al.).
Modifiers-recyclers are also positioned into their roles as assessors by their years of experience and through support of colleagues. Iczi and Siegel (2015) also emphasized how teaching experience and colleague support are some of the factors to consider when they studied a chemistry teacher who did not use appropriate tasks to support her assessment construct. Teachers in this study discussed their role in their collaboration team as a new teacher. On account of having less experience, new teachers shared how they trusted more experienced teachers who wrote the assessments previously. For instance, one teacher stated, “I will just trust teachers who have been doing it longer than I have” (Frederick, Focus Group #3, April 13, 2017). As new teachers they may lack the confidence, content knowledge, or time to re-design assessments. One teacher stated, “I think being new too...you get scared...maybe I want to change something but I don’t know if it would be the right thing for me to change” (Frederick, Focus Group #3, April 13, 2017). New teachers may experience fear of trying something new if the more experienced teachers in their collaboration team are not open to the changes; therefore, they take on a modifier sub-identity along with their team.

As suggested in a study by Gitlin (2001), structural constraints within the school or collaboration team may guide teachers to make hazardous decisions to save time or for fear of the unknown. For example an experienced teacher stated, “I would think that would be tough to...go into a unit not knowing this is what I need to get to” (George, Focus Group #3, April 13, 2017). This teacher is fearful of creating a new assessment after a unit has begun as well as concerns with not knowing what the assessment will look like at the end.

Another experienced teacher expressed concerns about too many changes at one time by saying, “it’s hard to keep up to date on everything,” “there’s a risk of failing,” and “do what you’re more familiar with and know it’s effective” (James, Focus Group #4, April 24, 2017).
Teachers have been tasked with aligning their instruction to NGSS and now they need to align their assessments. Modifiers-recyclers are experiencing many external pressures and they may feel overwhelmed and revert back to traditional assessment decision making. Similar to Dodson’s (2015) study, teachers adjusted to more mechanical, traditional forms when external pressures increased. When the teachers experienced fatigue from adjusting to too many changes they reverted to making decisions according to what they knew had worked in the past.

Experienced teachers make more traditional assessment decisions in a collaboration team due to fatigue or contextual factors that may provide a space of authoring for new teachers to re-author their script. Although new teachers may know NGSS and its terminology, they may position themselves underneath the more experienced teachers for team consensus. As one new teacher said, “If I was doing it myself, I might not pick those things” (Emily, Interview #3, May 18, 2017). Thus, modifiers-recyclers may have a range of the number years of experience, they may be fearful or not open to change and taking risks, do not feel they have time to seek out resources, and may be re-authoring their assessment sub-identity to fit their positioning within their collaboration team.

Sub-Identity #2: The Feeler-Finder

The second assessment sub-identity that surfaced through the voices of high school science teachers was the feeler-finder. The feelers-finders in this study can be seen through comments like, “...writing my own [assessment], I’ve never been good at it”, “I try to pick the best ones that I can find” (Sue Ellen, Interview #3, May 12), and “I like that question” (Sue Ellen, Interview #1, April 27). Unlike the modifiers-recyclers, the feelers-finders may jump back and forth between facilitators and assessors depending on the societal context, as suggested in
studies by Ecclestone and Pryor (2003), and Pryor and Crossouard (2010). Feelers-finders may be more of a facilitator of NGSS in instruction rather than a three-dimensional assessor. For instance, one teacher said, “I’m sure some of our short answers are three-dimensional” (Samantha, Focus Group #4, April 24, 2017). The feelers-finders are aware of the three dimensions, but do not explicitly review them when making an assessment. They rely more on their feelings about the standards than the standards alone.

The feelers-finders may “feel” or “know” when an assessment is more three-dimensional, but they do not create them. Instead they try to find examples or questions that may be more three-dimensional. Although they may not create their own questions, they are inquisitive on how others developed their assessments. This is evident by the comment, “How did you come up with that?” (Claire, Focus Group #3, April 13, 2017). The feelers-finders are more open to using three-dimensional assessments, but make assessment decisions based on what they like in the moment. Therefore, feelers-finders negotiate their alignment to NGSS and may make assessment decisions to include more three-dimensional assessments, if it feels right or aligns with their own assessment philosophy.

In a similar empirical study by Daghan and Akkoyunlu (2014), reasons why teachers may not use PBAM’s in the classroom were examined. One of the findings was that some of the teachers moderately implemented PBAM’s and negotiated their assessment decisions in order to align with their own assessment philosophy. This finding is similar to the feeler assessment sub-identity. The feeler will negotiate their sub-identity by making three-dimensional assessment decisions that happen to align with their own beliefs.

The feeler sub-identity may emerge during times of change. The shift to NGSS and three-dimensional assessments would be considered a time of change for the high school science
teachers at Cottage Hill. Because these assessment sub-identities are not static (Holland et al., 1998), feelers-finders may negotiate their identity as new three-dimensional assessment practices are introduced. This concept was addressed in the study by Xu and Brown (2016). They suggested that teachers negotiate their identity as an assessor throughout their career and during times of change.

The feelers-finders may also negotiate their alignment to NGSS due to external pressures. The implementation of NGSS is a state mandate. Teachers are supposed to align their curriculum and instruction according to the three-dimensional framework. Because high school science teachers are in a less powerful figured world than policymakers and the state board of education, they may have to re-author their scripts as assessors because of outside pressures. This is similar to findings from Beijaard, Meijer, and Verloop (2004), who conducted an analysis of research on identity. They suggested that negotiation of identity is dynamic and woven together with the pressures suppressed on teachers from society, as well as teachers’ internal pressures to meet their own expectations.

The feelers-finders are similar to the hopeful teacher identity constructed in the study by Bower (2012). Within the figured world of school culture, Bower suggested that the hopeful teacher may take on new changes or mandates but will tinker with them to fit his or her own personal beliefs. Therefore, feelers-finders may incorporate pieces of three-dimensional assessments into their assessment decision making or tinker with some of their assessment decisions to be more aligned to NGSS. They do not fully embrace the paradigm shift of NGSS but will make decisions on what to include based on their feelings about what aligns with their assessment philosophy.
For example, feelers-finders may embrace incorporating science and engineering practices (SEPs) into their assessments because they feel that is what science is about; however, they may not intentionally weave together SEPs with disciplinary core ideas and cross-cutting concepts when making assessment decisions. The incorporation of SEPs may not be that different from what they were trying to do in past practice; however, some of the teachers in this study voiced lack of time and resources were some of the reasons why they did not make three-dimensional assessments. According to research conducted by Izci and Siegal (2015), who studied a high school chemistry teacher, the teacher voiced value in developing assessments that required students to use science practices but she did not make assessment decisions to assess them properly. One of the emergent reasons for this was lack of time and materials. Therefore, feelers-finders may have good intentions to seek out three-dimensional questions, but may be ill-equipped to develop them on their own.

According to Holland et al. (1998), individuals can negotiate their identity through their own sense of agency and dialogue. In this study, feelers-finders emerged as those who negotiate their assessment sub-identity through their use of NGSS terminology or lingo. The language of NGSS is a system of meaning in the figured world of NGSS assessors and the creator sub-identity. Similar to the study by Bartlett (2007), who found adult Brazilian literacy students used artifacts such as books to seem or appear literate in their figured world, the findings from this study suggest that teachers’ use of NGSS language make them appear to be knowledgeable of NGSS and three-dimensional assessments. So, while communicating, feelers-finders may use NGSS acronyms because they are aware of them, but may not actually know what they represent or their components. Thus, they have not fully internalized the paradigm shift, but they are willing to try to use the language.
Feelers-finders may also attempt to use the new terms because they may be fearful of appearing NGSS illiterate and experience feelings of shame or judgment from their colleagues. For example, Ernest revealed that he needed to use the new jargon so others would think that he is including them when making assessment decisions. Ernest also referred to NGSS terminology as a “power weapon” and stated “Don’t beat me with terminology” (Interview #2, May 5, 2017). For Ernest, who sees himself as the “old guy” or experienced teacher, may not be “invited” into the figured world of NGSS and therefore feels excluded. Although he does not accept the paradigm shift, Ernest recognizes the power of utilizing the NGSS language to make it “seem” as if he is making three-dimensional assessment decisions. Because Ernest may be attempting to use the new language, he may also re-author his script (Pennington, 2007; Thomas, 2005), and navigate between figured worlds through dialogue with his colleagues (Adie, 2013; Sloan, 2006).

The high school science teachers in this study also described experiences where they could try on new identities and act out the role of assessor and the creator sub-identity. This is similar to how the medical students in the study by Vagan (2011) were able to act out the role of physician during medical school through the use of specific artifacts. Medical students’ social interactions in a figured world that supported physician behavior and positioning provided an opportunity for them to re-author their scripts and transform their identity from student to physician. Thus, the feeler sub-identity may act out the role of the creator sub-identity through agency, improvisation, and construction of new figured worlds and transform their identity. Re-authoring and the making of new worlds may occur through the support of colleagues, attending graduate school, experiences at conferences, and specific training on NGSS. For example, Sue Ellen described how she was able to internalize NGSS after participating in an NGSS writing committee with other colleagues who she respected. After becoming a member in that new
community or figured world, she had an opportunity to try on the creator sub-identity. Sue
Ellen’s acceptance, positioning, and agency in the writing committee may alter or negotiate her
assessment sub-identity.

Sub-Identity #3: The Creator

The third and final assessment sub-identity that materialized upon analysis of high school
science teachers’ descriptions of their assessment decision making was the creator. Within the
socially-constructed figured world of NGSS assessor, the creators emerged through quotes like,
“I sat down and tried to figure out how to do it [create a three-dimensional assessment]” (Drea,
Interview #2, May 3, 2017) and “I Googled 3D assessments” (Emily, Interview #2, May 11,
2017). Because creators are more likely to seek resources and practice developing three-
dimensional assessments, they have internalized the paradigm shift of NGSS with their own
identities as assessors (Daghan & Akkoyunlu, 2014) and may navigate between the figured
worlds of teachers and policymakers through dialogue (Sloan, 2006).

In a study by Sloan (2006), Anne, the born teacher, obtained the knowledge and ability to
move between several figured worlds. She was able to use language in the figured world of
policymakers to maneuver herself to be placed into a more powerful position to advocate for her
students. Rather than resist or tinker with the mandated policy, Anne was able to effectively
communicate across figured worlds and re-negotiate her identity.

Similar to the conceptualization of the born teacher identity, creators possess NGSS
knowledge to be positioned into figured worlds that are more powerful. Therefore, creators focus
on the three dimensions of NGSS when making assessment decisions. Because the creator sub-
identity may fully internalize the paradigm shift of weaving SEP’s, CCC’s, and DCI’s all together, they intentionally develop their instruction and assessment around them.

Along with possessing NGSS knowledge, creators are fluent in the NGSS language. Similar to other research studies (Bartlett, 2007; Vagan, 2011; Vetter, 2012), fluency of NGSS language may challenge teachers’ positioning. Therefore, creators in the figured world of NGSS assessors provide a space for teachers to become change agents rather than passive actors in the figured world of teaching. Thus, NGSS terms, acronyms, and three-dimensional assessments construct the system of meaning inside the figured world of the creator sub-identity.

According to Holland et al. (1998), identities are “lived” in the moment and are constantly negotiated through social positioning in figured worlds. So, teachers may move in and out of the three assessment sub-identities based on their experiences, knowledge, beliefs, feelings, collaboration, and sense of agency. Depending on the societal context, teachers have capacity to script multiple assessment sub-identities that are contradictory and may change based on power and positioning. For example, Emily, who has been in the science department at Cottage Hill for only two years, is positioned into the role as the new teacher. In her first year, Emily was a member of the Biology team and supported them in re-designing their curriculum to align with NGSS. As a new graduate, Emily appeared to be fluent in NGSS. The Biology team positioned her as a creator and supported her in making assessment decisions that were more three-dimensional and aligned with her assessment philosophy. During the time of this study, Emily was a member of the Honors Biology team. In the Honors Biology team, Emily discussed how she re-authored her script and became more of a modifier. She expressed how she may have made decisions in the team that she would not have made if she was alone or on another team. As a new member of the team, she took on the overall identity of the team as a modifier.
Towards the end of the year she began to re-write her identity as a creator after the team positioned her as “the one with great ideas” to make things more aligned to NGSS. Having Emily on the Honors Biology team may also influence the scripts of the other members of the team.

Reconsideration of the Framework

The most noteworthy implication from this study is the reconsideration of the Socio-cultural Identity Theory. Figure 2 is a representation of the refined theoretical framework based on the key assertions that emerged throughout this study. As shown in the representation, high school science teachers in this study are positioned into different figured worlds and assessment sub-identities: the modifier-recycler, the feeler-finder, and the creator. Teachers’ experiences, knowledge, beliefs, feelings, collaborative relationships, and sense of agency through dialogue and use of three-dimensional assessments construct their assessment sub-identities in the moment. Within the figured world of teaching are other socially-constructed figured worlds where not everyone is granted access due to lack of agency and fluency of the language. Teachers may move across figured worlds and re-author or negotiate their assessment identity through their sense of agency and dialogue.

The reconstruction of Holland et al.’s (1998) framework is important when considering implications for teachers, district administration, policymakers, and researchers. The various stakeholders may use the framework to improve their understanding of how high school science teachers negotiate their assessment identities through their own sense of agency and dialogue. It is important to understand that teachers’ assessment identities are fluid and may move between modifiers-recyclers, feelers-finders, or creators based on the teachers’ collaboration team, experiences, knowledge, beliefs, and feelings. Teachers are not stationed in just one sub-identity
but can move continuously based on their positioning within the figured world. Understanding high school science teachers’ perspectives based on their assessment identity during times of change and how teachers make three-dimensional assessment decisions will inform stakeholders in other figured worlds. This is more clearly indicated in Figure 2.

Figure 2: A visual representation of a refinement of Holland’s et al. (1998) Socio-cultural Theory of Identity in relation to the three emergent assessment sub-identities. Teachers can move in and out of the assessment sub-identities through their sense of agency and dialogue.

The findings from this study add to the Sociocultural Identity Theory framework for multiple reasons. First, each of the different courses or collaboration teams’ acted as figured worlds within the larger figured world of teaching. Each of the collaboration teams had their own systems of meaning and teacher roles. Second, this study addressed how one teacher identified as
a creator in a collaboration team one year and then re-authored her script as a modifier-recycler in a different collaboration team the next year. Thus, teachers’ negotiation of their assessment sub-identity is not a linear progression from modifiers-recyclers to feelers-finders and then creators. Teachers continuously negotiate their assessment sub-identity from one sub-identity to another based on how they are positioned in their collaboration teams.

Other Implications and Recommendations

Although the data from this study is limited to the context of Cottage Hill High School, the findings from this study may offer implications and recommendations for other high school science teachers, instructional coaches, teacher education, district administration, state policymakers, and researchers.

High School Science Teachers

While this study focused on teachers’ descriptions of their assessment decision making when making three-dimensional assessments, it is apparent in the first key assertion that very few teachers in this study have experienced the process of creating new three-dimensional assessments. This study is important in its recognition that the majority of the teachers in this study were identified as modifiers-recyclers or feelers-finders rather than creators. Even though NGSS encourages teachers to have autonomy when developing three-dimensional assessments, more powerful figured worlds of policy-makers and district administrators continue to rely on outcomes from accountability assessments to measure teachers’ effectiveness (McMillan, Myran, & Workman, 2002; NRC, 1999). Thus, the dominant culture of standardization applies pressure and implicitly influences the assessment decision making of teachers to improve standardized
test data. Because teachers are so accustomed to this dominant culture, they may not be aware or understand why they are making their assessment decisions (McMillan, 2003). This implies that although NGSS encourages teachers to make autonomous three-dimensional assessment decisions, teachers are still actors in the current power structure which disempowers teachers and makes them tools of policy-makers and national agendas.

All of the teachers in this study have been tasked with designing three-dimensional assessments according to the standards mandated by the State of Illinois; however, most of them are struggling to do so. Similar to previous research on identity formation (Bower, 2012; Freedman & Appleman, 2008; Kawasaki, 2015; Sloan, 2006), the three assessment sub-identities from this study are important because they reveal why and how high school science teachers make assessment decisions that align very little, moderately, or not at all with three-dimensional assessments. Therefore, assessment professional development should address these assessment sub-identities to make sense of high school science teachers’ assessment decisions in the figured world of teaching.

The teachers in this study had the opportunity to reflect on their experiences of making assessment decisions, become aware of their decision-making process, and make meaning of their decisions. Many of the teachers used vulgar language and took part in passionate conversations. Such language and passions suggests teachers should be encouraged to continue these conversations to reflect on their roles as assessors rather than facilitators of learning and to be aware of the assessment sub-identity they are most of the time. They can use that information to self-reflect and identify their role as an assessor in order to re-author their script. Teachers could create a reflection worksheet that would specifically address their assessment sub-identities.
Izci and Siegal (2015) found from studying one high school chemistry teacher that she voiced the importance of SEP’s but did not assess them appropriately. The 19 high school science teachers in this study felt more comfortable with SEP’s because that is “doing” science; however, this study also revealed teachers’ tensions with explicitly including CCC’s when making their assessment decisions. There is a lack of professional development for high school science teachers specifically on how to write assessments where students need to use a CCC in order to perform a skill for a specific concept.

Also, this study revealed that not all of the high school science teachers were fluent in the NGSS language. Teachers would variably resist using the terminology, use the terms fluently, or say the acronyms without knowing what they represented. It would be helpful for these teachers to have a document to follow that provides the components of all three dimensions and provides a checklist or prompts to assist teachers in developing questions that explicitly assesses all three of the dimensions rather than just two at a time. This will help them to be more mindful and have the resources available in one document to intentionally weave the three dimensions together. Because this study revealed teachers’ lack of NGSS knowledge and ability to assess CCC’s, once teachers feel comfortable using the NGSS language they should develop a rubric or template to use when making assessment decisions and developing three-dimensional assessments.

All of the teachers in this study referred to their learning goals as a tool they utilized when making assessment decisions. Teachers should explicitly write their learning targets so that they address all three dimensions. Having explicit three-dimensional learning targets for teachers to use might prompt teachers to develop assessment questions that assess all three dimensions.

If developing a workshop for high school science teachers based on the findings from this study, some of the key points to emphasize for teachers include:
- Don’t be afraid to talk to colleagues through intense conversations in order to become aware of your assessment decision-making process and negotiate your identity as an assessor.
- Recognize the power that you have been given to create three-dimensional assessments.
- Don’t hesitate to use the language of NGSS in order to make and move across figured worlds.
- Utilize the NGSS resources that are currently available and advocate for more resources to be developed that explain the decision-making process of three-dimensional assessments.
- Build a professional learning network of science teachers in your area to encourage collaboration and increase their sense of agency.

**Instructional Coaches**

As mentioned previously, the findings from this study suggests that high school science teachers would benefit from personalized embedded professional development. High school science teachers in this study discussed their concerns with the lack of resources and workshops that specifically address the development of three-dimensional assessments. Rather than have broad and over-generalized institute days, science teachers would benefit from instructional coaches within their buildings providing targeted professional development. According to Stenberg, Karlsson, Pitkaniemi, and Maaranen (2014), in order to provide meaningful professional development it must be designed based on teachers’ starting point. Instructional coaches have the opportunity to work closely with teachers, meet them where they are when it comes to assessment decision making, and support them when attempting to try something new.
The role of instructional coaches is not to fix something but to provide opportunities for teachers to reflect on their decision making. Reflective coaching cycles with teachers may provide a space for authoring teachers’ assessment identity and become aware of their own sense of agency when making assessment decisions.

If developing a workshop for instructional coaches based on the findings from this study, some of the key points to emphasize include:

- Recognize and be aware of the paradigm shift in science education brought on by NGSS and become knowledgeable of the three-dimensional standards in order to design professional development for high school science teachers.
- Don’t be afraid to foster relationships with high school science teachers so that they feel comfortable voicing their frustrations with creating three-dimensional assessments in order to meet teachers where they are in terms of assessment practices.
- Be creative and offer opportunities for teachers within their school day to reflect and re-author their assessment identity.
- Seek out resources to support high school science teachers to gain the skills and tools necessary to create three-dimensional assessments, take risks when designing performance-based assessments, and think outside the box.
- Encourage science teachers to participate in coaching cycles focused on developing three-dimensional learning targets and assessments.

**Teacher Education**

Along with reporting frustrations with the lack of time and resources to develop three-dimensional assessments, the high school teachers also voiced a lack of assessment literacy and
confidence in themselves as assessors. According to DeLuca and Bellara (2013), even with professional development, teachers continue to feel ill-prepared when tasked with developing assessments. This feeling seem to be intensified when teachers attempt to create performance-based assessments that are three-dimensional. Teachers’ assessment literacy should begin during pre-service teacher education.

Given the opportunity to speak to teacher educators, the following recommendations would be:

- Reflect upon and discuss how science courses are taught currently at the university level and how that may influence future science teachers’ assessment decisions.
- Advocate for the development of courses for pre-service teachers where they develop expertise in creating experiences for students to ask questions, develop models, argue from evidence, plan investigations, and design solutions.
- Model NGSS in classes specific for future science teachers so they can have experiences participating in three-dimensional instruction and assessment.
- Encourage collaboration and opportunities for groups of pre-service teachers to make assessment decisions and a space of authoring to shape their identity as both a facilitator and an assessor.
- Cultivate working relationships between in-service and pre-service science teachers so that together they may collaboratively improve their skills as assessors.

**District Administration**

The teachers in this study voiced their concerns for not having enough time and resources to develop new three-dimensional assessments. One-time training that superficially introduces
the three dimensions is not enough, due to teachers’ lack of knowledge, language, and willingness to take risks (Grainger & Adie, 2014). As teachers voiced in multiple focus groups and during interviews, they were aware of what the Biology team was doing and some of them learned that the Biology students were still successful when assessed three-dimensionally.

Teachers need positive experiences embedded within their day to create 3D assessments, allow for discourse with their team, have a safe place to try out the creator identity, and develop three-dimensional assessment rubrics. They also need opportunities to observe other teams making assessment decisions especially for those who are not open to change or have not internalized the NGSS paradigm shift. According to Howley, Howley, Henning, Gilla, and Weade (2013), when teachers work collaboratively they may feel safer taking risks with their assessments. Teachers may be more likely to think as assessors and re-author their assessment sub-identities.

District administration needs to provide teachers time throughout their professional day to create three-dimensional assessments and encourage collaborative relationships where teachers may negotiate their assessment identities. Also, administrators should offer opportunities for NGSS writing committees with teachers in their district to try on new identities offered such as the creator. It is also important for all district administrators to be fluent in NGSS and knowledgeable of three-dimensional assessments in order to support teachers.

Given the opportunity to speak to district administrators, the following crucial recommendations would be:

- Never underestimate the power of frank and intense conversations among teachers.
- Think creatively about creating time for teachers to collaborate during the school day.
• Encourage instructional coaches to facilitate meetings to support teachers as they negotiate their identities as assessors.
• Become well versed in the dimensions of NGSS in order to become instructional leaders for science educators.
• Advocate for the development and use of three-dimensional assessments that measure three-dimensional student learning.

Policymakers

Policymakers, who acquire identities in more powerful figured worlds, should also be aware of teachers’ assessment sub-identities when making policy decisions. This study is important for policymakers because it examines how teachers negotiate their identities due to mandates and societal pressures. Policymakers should be aware that teachers rely on traditional assessments and feel ill-prepared to create three-dimensional assessments. This study serves as a call for policymakers to enact assessment reforms that encourage teachers to take risks and create performance-based assessments to measure student learning rather than rely on traditional methods.

As mentioned previously, the high school science teachers in this study requested more time and resources to become creators and make three-dimensional assessments. When policymakers are making decisions that require teachers to change their practices, they must also provide time and resources for teachers to be successful. The Illinois State Board of Education should provide examples of what a three-dimensional assessment looks like and also provide the author’s decision-making process on how it was developed and why it was designed in that way.
Once teachers know the steps that experts took in developing questions, they will feel confident enough to try on their own and thus re-author their scripts and align to NGSS.

Similar to the recommendation to the districts, policymakers in the state of Illinois should also provide more opportunities for high school science teachers to collaborate through dialogue in NGSS writing committees. Sue Ellen’s participation in the local writing committee that she was invited into provided an experience where she could try on the creator sub-identity. This was a transformational experience that more high school science teachers need to be involved in. Because collaboration is a powerful piece in negotiating assessment identities, it would be even more powerful if teachers all throughout the state were able to communicate with each other about their assessment practices.

If given the opportunity to speak to policy-makers on how to implement powerful policies that could enhance science education based on the findings from this study would be:

- The successful implementation of a policy requires buy-in from all stakeholders.
- Never underestimate the power of teachers to make education policies become successful.
- Be aware of the three assessment sub-identities and understand how teachers negotiate their identities as assessors.
- Design policies that encourage teachers to assess students’ learning rather than focus on standardization.

Researchers

More research needs to be done on high school science teachers’ assessment identities as teachers continue to develop three-dimensional assessments and navigate times of change.
Quantitative research and large scale surveys that address similar information regarding teachers’ assessment decision making should also be explored. Science teachers could be surveyed across the country to see if they identify with the same emergent assessment identities.

Qualitative and quantitative research should also be conducted with teachers in disciplines other than science, who have made changes to their instruction or assessments due to mandates from policymakers, to learn if teachers negotiate their identity similarly. Similar studies should also be done with district administrators, department chairs, curriculum coordinators, and instructional coaches. It would also be beneficial to conduct research focused on policy-makers as they are developing the next science standards to gain understanding of their assessment decision making.

Because Cottage Hill has a culture of collaboration, schools where teachers work more in isolation should also be studied. It would be interesting to see if those teachers then seek out more colleague support and create worlds or committees to collaborate. Also, because Cottage Hill is located in an affluent community with little diversity in the community or among the staff, it would be beneficial for researchers to study high school science teachers who teach in more diverse environments.

It would be beneficial to study the same department five years from now or a school similar to it demographically. It would be interesting to see if the same three sub-identities emerged, if new ones formed that are unimaginable currently, or if one of the sub-identities no longer exists.
Conclusion

This study addressed the lack of research regarding high school science teachers’ assessment decision making when developing three-dimensional assessments. The goal of this study was to amplify the voices of high school science teachers and raise awareness of how the positionality of teachers in less powerful figured worlds within the dominant discourse of standardization may play a role in their decision making when developing three-dimensional assessments.

In order for teachers to align to the NGSS framework and create three-dimensional assessments, they need to be aware of their assessment identity as either: modifiers-recyclers, feelers-finders, or creators. Even though high school science teachers may share similar beliefs as NGSS and value “doing” science rather than just “knowing” science, they are struggling with making assessment decisions that correspond with their beliefs. Teachers are working within a political climate of standardized testing and accountability which may implicitly lead to feeling a lack of control in making assessment decisions. There are many elements that play a role in the authoring of high school science teachers’ assessment identities; however, it is through their own sense of agency and dialogue in socially-constructed figured worlds where teachers may rewrite their script as assessors.
REFERENCES


APPENDICES
APPENDIX A

DISSERTATION STUDY CONSENT FORMS
Dissertation Study Informed Consent for Focus Groups

I agree to participate in the research project “The Secret Life of Three Dimensional Assessment Decisions: Voices of High School Science Teachers' Perspectives” being conducted by Megan Ewald, a graduate student at Northern Illinois University. I have been informed that the purpose of the study is to examine high school teachers’ perspectives on the reasons for their decision making in developing three dimensional assessments.

I understand that if I agree to participate in this study, I will be asked to participate in a focus group lasting approximately 60 minutes and provide example assessments. The focus group will take place at 3:30 p.m. on an agreed upon date, in the science department office.

I understand that only 3-5 participants in the focus group will be asked to participate in 2-3 interviews based on the responses during the focus group meeting. I am aware that if I agree to participate, the interviews will take place over 2-3 weeks and last approximately 30-60 minutes each. I am also aware that I may be asked to participate in a 10-20 minute think-aloud before the final interview session. I may be asked follow-up questions via email or by phone.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Megan Ewald at (708) 268-8920 and doctoral advisor Mary Beth Henning at (815) 753-8591. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815) 753-8588.

I understand that the intended benefits of this study include the addition of teachers’ voices surrounding the topic of science assessments in order to inform decisions in education.

I understand that all information gathered during this study will be kept confidential by using pseudonyms and all transcripts will be kept confidential. I also understand that, when participating in a focus group, confidentiality among the members of the group cannot be guaranteed.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have received a copy of this consent.

Signature of Subject  Date

I consent to be audio recorded for the focus group.

Signature of Subject  Date

Northern Illinois University
March 17, 2017
Approved by NIU IRB
Void one year from above date
Dissertation Study Informed Consent for Interviews and Think-aloud

I agree to participate in the research project “The Secret Life of Three Dimensional Assessment Decisions: Voices of High School Science Teachers’ Perspectives” being conducted by Megan Ewald, a graduate student at Northern Illinois University. I have been informed that the purpose of the study is to examine high school teachers’ perspectives on the reasons for their decision making in developing three dimensional assessments.

I understand that I was chosen to participate in 2-3 interviews and a think-aloud based on my responses in the focus group. I will be asked to participate in 2-3 interviews that will take approximately 30-60 minutes each and participate in a 10-20 minute think-aloud process before the final interview session. The interviews will take place in a private setting at my convenience over two to three weeks. I understand in the think-aloud process I will be asked to record my thoughts and feelings that come up while developing a classroom assessment, with a digital voice recorder. I will complete the think-aloud at my convenience before the final interview session. I may be asked follow-up questions via email or by phone.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Megan Ewald at (708) 268-8920 and doctoral advisor Mary Beth Henning at (815) 753-8591. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815) 753-8588.

I understand that the intended benefits of this study include the addition of teachers’ voices surrounding the topic of science assessments in order to inform decisions in education.

I understand that all information gathered during this study will be kept confidential by using pseudonyms and all transcripts will be kept confidential.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have received a copy of this consent.

I consent to be audio recorded for the interviews.

___________________________________________ ______________________________
Signature of Subject Date

I consent to be audio recorded for the think-aloud.

___________________________________________ ______________________________
Signature of Subject Date
APPENDIX B

FOCUS GROUP DETAILED INFORMATION
### Focus Group Detailed Information

<table>
<thead>
<tr>
<th>Focus Group</th>
<th>Date/Time Held</th>
<th>Size of Group</th>
<th>Homogenous or Heterogeneous* Group</th>
<th>Participants</th>
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<tr>
<td>1</td>
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<td>4</td>
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<td>Ernest, Elizabeth, Mary Ann, Drea</td>
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<td>6</td>
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<td>Samantha, Sue Ellen, Emily, James, Chris, Dylan</td>
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</table>

* Heterogeneous means that the focus group included members from a variety of course teams.
APPENDIX C

FOCUS GROUP PROTOCOL
FOCUS GROUP QUESTIONS

Opening
1. Tell us your name and what you like most about teaching.

Introductory
2. What comes to mind when you think of assessment?

Transition
3. What do you think is most important to assess in a science classroom?
4. Describe your interactions with teachers in your team when making assessment decisions?

Key
5. Describe your thought process when deciding on the types of assessments to use in the classroom.
6. Describe your thought process while in the classroom on how you make day-to-day classroom assessment decisions?
7. How do you incorporate SEPs into your classroom assessments?
8. How do you incorporate CCCs into your classroom assessments?
9. How do you incorporate DCIs into your classroom assessments?
10. Describe an example assessment that measures the three dimensions.
11. How would you go about designing a three-dimensional assessment by yourself?
12. How would you go about designing a three-dimensional assessment with your course team?
13. Think back to your early experiences of writing assessments, how has it changed today? Why?

Ending
14. If you could choose the most important reason that influences your assessment decision making, what would it be and why?
15. I wanted to look at teachers’ reasons for their assessment decision making, how collaboration may play a role in the decision-making process, and how teachers negotiate their identities as assessors. Is there anything I missed or anything you wanted to add?
APPENDIX D
PILOT STUDY CONSENT FORMS
Pilot Study Informed Consent for Focus Group

I agree to participate in a pilot study for the dissertation study “The Secret Life of Three Dimensional Assessment Decisions: Voices of High School Science Teachers' Perspectives” being conducted by Megan Ewald, a graduate student at Northern Illinois University. I have been informed that the purpose of the study is to examine high school teachers’ perspectives on the reasons for their decision making in developing three dimensional assessments.

I understand that if I agree to participate in this study, I will be asked to participate in a focus group lasting approximately 60 minutes and provide example assessments. The focus group will take place at 3:30 p.m. on an agreed upon date, in the science department office at Megan Ewald’s place of employment.

I understand that only one to two participants in the focus group will be asked to participate in two to three interviews based the responses during the focus group meeting. I am aware that the interviews will take approximately 30-60 minutes each. I am also aware that I may be asked to participate in a 10-20 minute think-aloud process before the final interview session. I may be asked follow-up questions via email or by phone.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Megan Ewald at (708) 268-8920 and doctoral advisor Mary Beth Henning at (815) 753-8591. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815) 753-8588.

I understand that the intended benefits of this study include the addition of teachers’ voices surrounding the topic of science assessments in order to inform decisions in education.

I understand that all information gathered during this study will be kept confidential by using pseudonyms and all transcripts will be kept confidential. I also understand that, when participating in a focus group, confidentiality among the members of the group cannot be guaranteed.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have received a copy of this consent.

____________________________________________________________________
Signature of Subject __________________________ Date ______________________

I consent to be audio recorded for the focus group.

____________________________________________________________________
Signature of Subject __________________________ Date ______________________
Pilot Study Informed Consent for Interviews and Think-aloud

I agree to participate in a pilot study for the dissertation study “The Secret Life of Three Dimensional Assessment Decisions: Voices of High School Science Teachers' Perspectives” being conducted by Megan Ewald, a graduate student at Northern Illinois University. I have been informed that the purpose of the study is to examine high school teachers’ perspectives on the reasons for their decision making in developing three dimensional assessments.

I understand that I was chosen to participate in 2-3 interviews and a think-aloud based on my responses in the focus group. I will be asked to participate in 2-3 interviews that will take approximately 30-60 minutes each and participate in a 10-20 minute think-aloud process before the final interview session. The interviews will take place in a private setting at my convenience over two to three weeks. I understand in the think-aloud process I will be asked to record my thoughts and feelings that come up while developing a classroom assessment, with a digital voice recorder. I will complete the think-aloud at my convenience before the final interview session. I may be asked follow-up questions via email or by phone.

I am aware that my participation is voluntary and may be withdrawn at any time without penalty or prejudice, and that if I have any additional questions concerning this study, I may contact Megan Ewald at (708) 268-8920 and doctoral advisor Mary Beth Henning at (815) 753-8591. I understand that if I wish further information regarding my rights as a research subject, I may contact the Office of Research Compliance at Northern Illinois University at (815) 753-8588.

I understand that the intended benefits of this study include the addition of teachers’ voices surrounding the topic of science assessments in order to inform decisions in education.

I understand that all information gathered during this study will be kept confidential by using pseudonyms and all transcripts will be kept confidential.

I understand that my consent to participate in this project does not constitute a waiver of any legal rights or redress I might have as a result of my participation, and I acknowledge that I have received a copy of this consent.

I consent to be audio recorded for the interviews.

________________________________________________________________________
Signature of Subject Date

I consent to be audio recorded for the think-aloud.

________________________________________________________________________
Signature of Subject Date

Northern Illinois University
March 17, 2017
Approved by NIU IRB
Void one year from above date
APPENDIX E
INTERVIEW PROTOCOL
THREE SERIES INTERVIEW QUESTIONS

FIRST INTERVIEW: “How questions”
1. Tell me a story of how you became interested in teaching science?
2. Tell me about your early experiences of how you developed science assessments?
3. How has your experience in developing assessment changed over time?
4. Walk me through a typical day in your classroom and how you assess students learning?
5. Describe for me how you would consider your assessment practices to be aligned with NGSS?
6. Describe for me an assessment that your collaboration team gave to students recently? What did it look like?
7. Tell me a story about a time when you disagreed with your collaboration team about an assessment decision?
8. If you had a chance to pick your collaboration team, how would you go about it and what would it look like?

SECOND INTERVIEW: “Details of experiences”
1. Based on your earlier experiences with developing science assessments, as mentioned in the last interview, explain how decisions of what to include or not to include were made?
2. Based on what you shared last time, specific to how you assess student learning on a typical day, tell me how you made those decisions?
3. How do you try to put the three dimensions (SEPs, CCCs, DCIs) together when making a classroom assessment?
4. Provide some details on factors that influence your decisions when developing or using 3D assessments.
5. Walk me through the process of how your collaboration team decided on how the recent assessment that you mentioned in the first interview was designed?
6. Based on your experiences of disagreements with your collaboration team mentioned in the first interview, how do your assessment decisions differ from your collaboration team?
7. Provide some details on how other teachers have influenced your assessment decisions.
8. Would you like to share more details from the experiences you mentioned in the first interview that were not already discussed?
(The teacher will be asked to participate in a think-aloud while developing a classroom assessment before the final interview. The teacher will also be asked to bring the assessment with them to the next interview)

THIRD INTERVIEW: “Reflection of meaning attached to experiences”

1. After going through the think-aloud, what are some of your reflections?
2. How would you describe your decision-making process in developing that assessment?
3. Explain the reasoning behind your decisions in developing that assessment?
4. In the last two interviews you spoke about how you assess your students on a typical day, why did you decide to make those assessment decisions?
5. You explained how your experiences in developing assessments have changed over time, why have your decisions changed?
6. Looking again at the assessment that you brought with, how would you change it to be more three-dimensional? Why?
7. Thinking back to the assessments and experiences you have shared with me, why did you make those assessment decisions?
8. Do you think your decision making will change in the future?
APPENDIX F

INTERVIEW AND THINK-ALOUD DETAILED INFORMATION
<table>
<thead>
<tr>
<th>Pseudonyms of Participants</th>
<th>Interview #1</th>
<th>Interview #2</th>
<th>Interview #3</th>
<th>Think-aloud</th>
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<td>May 18, 2017 11:30-12:10 P.M.</td>
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<td>Sue Ellen</td>
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<td>Drea</td>
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<td>Emily</td>
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<td>Cal</td>
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<td>May 16, 2017 12:30-1:00 P.M.</td>
<td>May 15, 2017</td>
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APPENDIX G

THINK-ALOUD PROTOCOL
THINK-ALOUD PROTOCOL

DIRECTIONS: Through the process of developing a classroom assessment, I am interested in learning about what you think about when you are making your assessment decisions. By speaking into a digital voice recorder or cell phone voice recording app, I want you to tell me everything you are thinking. This includes your feelings, what you notice, and questions that you have as you go through the process of developing an assessment. Please keep talking out loud and use the following prompts to guide you if you get stuck or stop talking. You can email the digital voice recording file to me when you complete the think-aloud. Please bring the assessment that you developed to the next interview.

PROMPTS:

1. What are you thinking about now as you begin to make a decision about this particular assessment?

2. Why did you make a particular decision about this assessment?

3. How did you decide what to include?

4. How did you decide what not to include?

5. What are you struggling with regarding the assessment you chose?

6. What feelings or emotions are you experiencing?

7. Did you decide to incorporate Science and Engineering Practices in this assessment? If so, how?

8. Did you decide to incorporate Crosscutting Concepts in this assessment? If so, how?

9. Did you decide to incorporate Disciplinary Core Ideas in this assessment? If so, how?