An Investigation of Turkish Middle School Science Teachers’ Pedagogical Orientations towards Direct and Inquiry Instructional Approaches

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AN INVESTIGATION OF TURKISH MIDDLE SCHOOL SCIENCE TEACHERS’ PEDAGOGICAL ORIENTATIONS TOWARDS DIRECT AND INQUIRY INSTRUCTIONAL APPROACHES

by

Selcuk Sahingoz

A dissertation submitted to the Graduate College in partial fulfillment of the requirements for the degree of Doctor of Philosophy
The Mallinson Institute of Science Education
Western Michigan University
June 2017

Doctoral Committee:

William W. Cobern, Ph.D., Chair
Brandy Pleasants, Ph.D.
Amy Bentz, Ph.D.
One of the most important goals of science education is preparing effective science teachers which includes the development of a science pedagogical orientation. Helping in-service science teachers improve their orientations toward science teaching begins with identifying their current orientations. While there are many aspects of an effective science teaching orientation, this study specifically focuses on effective pedagogy. The interest of this study is to clarify pedagogical orientations of middle school science teachers in Turkey toward the teaching of science conceptual knowledge. It focuses on what instructional preferences Turkish middle school science teachers have in theory and practice.

The purpose of this study is twofold: 1) to elucidate teacher pedagogical profiles toward direct and inquiry instructional approaches. For this purpose, quantitative profile data, using a Turkish version of the Pedagogy of Science Teaching Test (POSTT-TR) assessment instrument, was collected from 533 Turkish middle school science teachers; 2) to identify teaching orientations of middle school science teachers and to identify their reasons for preferring specific instructional practices. For this purpose, descriptive qualitative, interview data was collected from 23 teachers attending a middle school science teacher workshop in addition to quantitative
data using the POSTT-TR. These teachers sat for interviews structured by items from the POSTT-TR. Thus, the research design is mixed-method. The design provides a background profile on teacher orientations along with insights on reasons for pedagogical choices.

The findings indicate that instructional preference distributions for the large group and smaller group are similar; however, the smaller workshop group is more in favor of inquiry instructional approaches. The findings also indicate that Turkish middle school science teachers appear to have variety of teaching orientations and they have varied reasons. Moreover, the research found that several contextual factors contributed to teachers’ instructional practices including internal and external issues such as school environment, limited resources, large class sizes, standardized test pressure, and limited accessibility to professional development. The findings provide insight on the readiness of middle school teachers to implement the Turkish Curriculum Framework, specifically, teacher readiness to put science inquiry instructional approaches into actual classroom practice. Given that new Turkish policy calls for greater inquiry instruction, this study can help inform teacher development efforts directed at promoting science inquiry instruction.
ACKNOWLEDGMENTS

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Then, I would like to thank Dr. Fatih Taşar for allowing me to conduct my dissertation research in his workshop for teachers. I would like to thank the teachers from the workshop who helped me with my dissertation research. They were sympathetic and open-minded people. I really appreciated meeting with each of them.

Lastly, I would especially like to thank my family. My wife Emel Şahingöz has made countless sacrifices to help me get to this point. I am so happy knowing she is always there for me no matter what. My little son Mehmet Alp Şahingöz is my best motivation because of his warm smile and lovely touches. My parents Mehmet and Gülcan Şahingöz deserve special thanks for their continued support. I come from an academic family and they encouraged me to become an academician. They never stopped supporting me over this rocky road to my PhD. My mother-in-law Nurten Acer deserves another special thanks for her prays and endless support.

Selçuk Şahingöz
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ACKNOWLEDGMENTS</th>
<th>LIST OF TABLES</th>
<th>LIST OF FIGURES</th>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii</td>
<td>viii</td>
<td>ix</td>
<td>1. THE PROBLEM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.1 Introduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.2 Theoretical Framework</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.3 Significance of the Study</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHAPTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. LITERATURE REVIEW</td>
</tr>
<tr>
<td>2.1 Introduction</td>
</tr>
<tr>
<td>2.2 Domain #1: Science Teaching Orientations</td>
</tr>
<tr>
<td>2.2.1 Definition of science teaching orientations</td>
</tr>
<tr>
<td>2.2.2 Common teaching orientations models and assessment instruments in science education</td>
</tr>
<tr>
<td>2.2.3 Translating science teaching orientations into practice</td>
</tr>
<tr>
<td>2.2.4 The relation between PCK and science teaching orientations</td>
</tr>
<tr>
<td>2.2.5 Summary</td>
</tr>
<tr>
<td>2.3 Domain #2: Science Instructional Approaches and Characteristics</td>
</tr>
<tr>
<td>2.3.1 Common learning approaches</td>
</tr>
<tr>
<td>2.3.2 Instructional strategies and approaches</td>
</tr>
</tbody>
</table>
Table of Contents - Continued

CHAPTER

2.3.4 Effective instructional approaches ................................................................. 40
2.3.5 Comparison of direct instructional and inquiry instructional approaches ........ 44
2.3.6 Summary .............................................................................................................. 49

2.4 Domain #3: Contextual Factors Effecting of Middle School Science Teachers in Practice ......................................................... 49
2.4.1 Common external contextual factors impact on science teachers’ pedagogical orientations.................................................................................. 50
2.4.2. Summary ........................................................................................................... 57

2.5 Synthesis of the Literature .................................................................................... 58
2.6 Purpose of the Study ............................................................................................ 59
2.7 Research Questions ............................................................................................... 60

CHAPTER

3. METHODOLOGY ....................................................................................................... 61
3.1 Research Design .................................................................................................... 61
3.2 Instrumentation and Data Sources ........................................................................ 62
3.2.1 The POSTT-TR survey instrument ................................................................... 63
3.2.2 Interviews ......................................................................................................... 64
3.3 Participants and Sampling ..................................................................................... 65
3.4 Data Collection Procedure ................................................................................... 68
3.5 Data Analysis ......................................................................................................... 70
3.5.1. Quantitative data analysis ............................................................................... 71
### Table of Contents - Continued

**CHAPTER**

3.5.2 Qualitative data analysis ........................................................................................................... 71

3.5.3 Generalizability ......................................................................................................................... 72

**CHAPTER**

4. RESULTS AND DISCUSSION ......................................................................................................... 74

4.1 Introduction ................................................................................................................................. 74

4.2 Research Question One: What is the range of the pedagogical preferences among Turkish middle school science teachers with respect to POSTT-TR? ........................................ 75

4.2.1 Discussion: Research Question One .................................................................................... 79

4.3 Research Question Two: What do teachers’ pedagogical orientations appear to be and what reasons do they give for their pedagogical preferences? ........................................... 80

4.3.1 Quantitative analyses ............................................................................................................. 81

4.3.2 Qualitative analyses ............................................................................................................... 88

4.3.3 Discussion: Research Question Two .................................................................................... 108

4.4. Research Question Three: What contextual factors impact the teachers’ implementation of classroom instructional practices? ............................................................ 110

4.4.1 The availability of materials and facilities for doing science activities ......................... 111

4.4.2 The need to prepare students for the 8th grade standardized test ................................. 114

4.4.3 Concerns about overcrowded classrooms and management ........................................ 117

4.4.4 Student related issues impacting instructional choices ..................................................... 118

4.4.5 Mandates from school administrators ............................................................................. 123
**Table of Contents - Continued**

**CHAPTER**

4.4.6 Turkish education policy and curriculum .......................................................... 123

4.4.7 Discussion: Research Question Three ............................................................... 124

4.5 Research Question Four: How do teachers explain their actual classroom instructional practices? ........................................................................................................... 126

4.5.1 Direct oriented (quite direct oriented) teachers .................................................. 126

4.5.2 Direct oriented (active direct oriented) teachers ............................................... 127

4.5.3 Inquiry oriented (more consistently inquiry oriented) teachers ......................... 130

4.5.4 Inquiry oriented (inquiry but direct too) teachers ............................................. 132

4.5.5 Mixed oriented (transitional oriented) teachers ............................................... 134

4.5.6 Mixed oriented (context dominated oriented) teachers ................................... 136

4.5.7 Confused oriented teachers .............................................................................. 137

4.5.8 Discussion: Research Question Four .................................................................. 138

**CHAPTER**

5. CONCLUSIONS AND IMPLICATIONS ........................................................................ 139

5.1 Conclusions ............................................................................................................ 139

5.2 Strengths and Limitations ..................................................................................... 144

5.2.1 Strengths .......................................................................................................... 144

5.2.2 Limitations ....................................................................................................... 145

5.3 Implications ........................................................................................................... 145

5.4 Future Research ................................................................................................... 147
# Table of Contents - Continued

REFERENCES ........................................................................................................................................... 148

APPENDICES ........................................................................................................................................... 158
  A. Human Subjects Institutional Review Board Approval and Consent Form ......................... 158
  B. POSTT Assessment Instrument (English Version) ................................................................. 165
  C. POSTT Assessment Instrument Answer Key ........................................................................ 177
  D. POSTT-TR Assessment Instrument (Turkish Version) ......................................................... 179
  E. POSTT-TR Assessment Instrument Answer Key (Turkish) ............................................... 188
  F. Interview Protocol ....................................................................................................................... 190
  G. Data Summaries of Workshop Teachers .................................................................................. 192
LIST OF TABLES

1.1 Science Teaching Orientation Spectrum.......................................................................................... 9

2.1 Ranking of Teaching Strategies ......................................................................................................... 48

3.1 Returned Survey Distribution from the Cities with the Regions ...................................................... 66

3.2 Demographic Information of Workshop Sample.................................................................................. 67

3.3 Summary of Data Collection Procedure ............................................................................................ 69

4.1 Teacher Response Variation Across 533 Turkish Science Teachers................................................... 75

4.2 Aggregated Direct and Inquiry Instruction Responses Across 533 Turkish Science Teachers................................. 77

4.3 Aggregated Direct and Inquiry Instruction Responses Across 533 Turkish Science Teachers................................. 78

4.4 Instructional Approach Choices With Respect to Grade Levels Across 533 Turkish Science Teachers ........................................................................................................................................ 78

4.5 Teachers Response Variation Across Workshop Sample and National Sample .................... 81

4.6 Item Response Distribution Across Four Instructional Approaches 
(Workshop vs. National) .......................................................................................................................... 82

4.7 Item Response Distribution Aspect of Direct and Inquiry Instruction for Two Samples ...... 84

4.8 Crosstabulation Statistical Analysis of Both Sample Item Responses for POSTT-TR Items .................................................................................................................................................. 86

4.9 Teacher and Instructional Practice Variation Across Workshop and National Samples ...... 87

4.10 Instructional Approach Choices With Respect to Grade Levels Across Workshop and National Samples ................................................................................................................................................. 87

4.11 Teaching Orientation (TO) Types of Workshop Sample Teachers ............................................. 90
LIST OF FIGURES

1.1. Theoretical Framework of Knowledge for Teaching: Friedrichsen et al. version of Magnusson et al. Model .................................................................................................................. 5

1.2. Lee and Luft Comparison of PCK Models ......................................................................................... 7

2.1. Structure of the Literature Domains ........................................................................................................ 11

2.2. Ausubel’s Axes .................................................................................................................................. 45

3.1. The Survey Attendant Cities of Turkey Highlighted in Red Color ................................................. 67

4.1. Item Response Distributions of Four Instructional Approaches across 533 Turkish Science Teachers .................................................................................................................. 76

4.2. Histogram of Item Response Distribution across Four Instructional Approaches (Workshop vs. National) .................................................................................................................................. 83

4.3. Workshop Sample Item Response Distributions (%) ........................................................................ 84

4.4. National Sample Item Response Distributions (%) ........................................................................ 85
CHAPTER 1

THE PROBLEM

1.1 Introduction

Modern science teaching standards require reforming teacher practice at all grade levels (NRC, 1996, 2000, 2012; NGSS, 2013). One of these changes is teaching science content through inquiry. The Turkish curriculum was revised in 2006 and 2013 by Ministry of National Education (MoNE) to pursue this hot topic. In 2006 (TCF, 2006), constructivist approaches were purposefully integrated into the Turkish Curriculum Framework. In 2013 (TCF, 2013), the Turkish Curriculum Framework was further revised. Scientific literacy and science process skills have been shifted to the center of the curriculum. Correspondingly, in-service science teacher training programs, workshops, and the Board of Education and Discipline promote inquiry-based teaching and require that science teachers both comprehend inquiry skills and use inquiry appropriately rather than to use direct instruction in their classrooms. The MoNE concern, however, is that in-service teachers may be unprepared for the changes. Indeed, MoNE has little knowledge to what extent teachers implement inquiry instructional approaches and what reasons influence their pedagogical choices.

Concern to improve science teacher efficacy is motivated by international student achievement and assessment tests indicating student progress toward expected content learning and science process skill goals. Turkish policymakers and educators have attached importance to standardized test results especially after recent revisions of the Turkish Curriculum Framework
The latest international science assessment tests, however, reveal little increase in Turkish students’ science achievement. The scores of Turkish students on the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Science Assessment (PISA) are average or below with respect to the countries tested. Based on the TIMSS-2015 results (Martin et al., 2016), Turkey ranked 35th of 47 participant countries in fourth grade students’ science achievement, and ranked 21st of 39 participant countries in eighth grade students’ science achievement. The scores of both grade levels are below, but very close to, the international average.

My interests are with Turkish middle school students and their teachers. According to the TIMSS International Benchmarks (Martin et al., 2016), Turkish eighth grade students met intermediate benchmarks. These students are able to demonstrate and apply their knowledge about science in various contexts. However, they perform poorly on advanced benchmarks. Based on the TIMSS International Benchmarks (Martin et al., 2016), this means Turkish middle school students have difficulty applying science concepts in both everyday and abstract situations, in practical and experimental contexts. With respect to the TIMSS science cognitive domains of knowing, applying, and reasoning, Turkish eighth grade students have higher applying scores than knowing and reasoning scores, but still all the scores are average or below. These scores show that Turkish middle school students are unable to adequately relate experiments or activities with learning objectives and with their daily life situations.

The PISA-2015\(^1\) test results for 15-year-old Turkish students (post-graduation from high school) are worse than TIMSS 2015. Turkish students’ science achievement scores ranked 55th

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out of 72 participant countries, which is below the international average. Moreover, the Turkish PISA-2015 results were lower than the PISA-2012\footnote{Retrieved from OECD website: \url{http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf}} results.

There is concern in Turkey that these results may indicate that the Turkish teaching of science is insufficiently effective and that could be a result of the poor implementation of inquiry-based teaching. One questions how successfully Turkish teachers implement inquiry-based teaching in the classroom, science laboratory, or on field trips. This question aroused my interest specifically about Turkish middle school science teachers. I have wondered about their inquiry-based teaching (or pedagogical) orientations and actual classroom practices. The latest Turkish curriculum revisions also encouraged me to examine these teachers’ pedagogical orientations alignment with Turkish educational policymakers’ expectations (of inquiry-focused education?). What are the influences on teachers’ actual instructional approaches? Are teachers unprepared for inquiry-based teaching in spite of in-service teacher training programs and workshops?

There are many questions one could ask but I found myself most interested in knowing more about Turkish middle school science teachers’ pedagogical orientations and their reasons for using various instructional approaches. If some teachers still prefer using direct instructional approaches instead of using inquiry instructional approaches, why? How do external contextual factors such as students, standardized tests, science materials and facilities affect middle school science teachers’ pedagogical choices? Are there differences between instructional preferences of these teachers and their actual classroom practice?
Considering these provocative questions, my focus shifted to identify Turkish middle
school science teachers’ orientations toward teaching science, and reasons for those orientations,
with regard to their instructional strategy preferences.

1.2 Theoretical Framework

I use the theoretical framework of pedagogical content knowledge (PCK) as a framework
for understanding how teachers perceive and employ instructional approaches in practice. PCK
tries to answer how teachers should develop instructional practices or strategies for a specific
context (Shulman, 1986a, 1987; NRC, 1996). With respect to content, a science teacher can have
orientations towards instructional strategies having to do with teaching the nature of science,
teaching science processes, as well as teaching science concepts. But, specifically I am interested
in teaching orientations with respect to teaching content. To successfully implement science
teaching orientations, in-service science teachers must understand both the science content
subject matter and also how to integrate the content and methods of science into equivalent
pedagogical practices. The knowledge of how to develop pedagogical practice for effective
teaching in the classroom is a matter of PCK.

I considered the structure of the Magnusson et al. (1999) PCK model, but I benefitted
from the Friedrichsen et al. (2009) version (Figure 1.1). This version of the model provides a big
picture that clearly presents PCK components as related with science teaching orientations and
instructional strategies. According to the Magnusson et al. (1999) PCK model, orientations
toward science teaching are characterized by four specific domains. These are knowledge of
science curriculum (specific curriculum and general science goals and objectives), knowledge of

4
students’ science understanding (students’ difficulties and background knowledge), knowledge of assessment in science (what to assess and how), and knowledge of instructional strategies in science (general science and topic-specific). In addition, influence teachers’ development of teaching orientations related also other domains to each of these knowledge components. These domains originated with Grossman (1990). They consist of teachers’ understanding of the subject matter, general pedagogical knowledge and an understanding of support and limitations of the teaching context (Abell, 2007). Starting from this point of view, it can be inferred that teachers’ instructional practice choices reflect their teaching orientations and provide information that can inform professional development.

Figure 1.1. Theoretical Framework of Knowledge for Teaching: Friedrichsen et al. (2009) version of Magnusson et al. (1999) Model (Cited in Nargund-Joshi, 2012, p.20)
While the literature review will focus on the Magnusson et al. PCK model, it is helpful to consider how a number of PCK models compare. Lee and Luft (2008) made such a comparison. They provided a table summarizing different PCK models using the categories: knowledge of subject matter, knowledge of representations and instructional strategies, knowledge of student learning and conceptions, knowledge of general pedagogy, knowledge of curriculum and media, knowledge of context, knowledge of purpose, and knowledge of assessment. Their comparison (Figure 1.2.) shows that almost all models indicate the importance of knowledge of instructional strategies by teachers and knowledge of student learning and conceptions (also misconceptions) – that teachers must learn what students know about a topic and areas of likely difficulty – more than the other components for explaining PCK. Although Lee and Luft (2008) found that a majority of researchers agree that all these concepts are important for constructing PCK, my particular interest is in instructional strategies. Therefore, the literature review of the study purposefully focuses on the component understanding the effect of teachers’ understanding about instructional strategies on science teaching orientations, rather than other components inherent in the PCK model.
Figure 1.2. Lee and Luft (2008, p. 1346) Comparison of PCK Models

Following the Magnusson et al. model, the particular interest of this study is to examine pedagogical orientations of Turkish middle school science teachers with respect to their instructional preferences and reasons.

1.3 Significance of the Study

Although several researchers and educators have worked on the idea of orientation towards teaching, there is still limited and vague information relevant to pedagogical orientations in science education (Friedrichsen, 2003; Abell, 2007; Nargund-Joshi, 2012). Few empirical studies have addressed the issue of science teachers’ pedagogical orientations over the last few decades (Magnusson et al, 1999; Friedrichsen & Dana, 2005; Friedrichsen et al., 2011; Boesdorfer & Lorsbach, 2014; Boesdorfer, 2015, Kind, 2016). Moreover, one must recognize that how science teachers actually teach may differ from what they are inclined to do. Teachers sometimes face problems in translating their orientations for teaching science into actual practice (Friedrichsen & Dana, 2003; Volkmann & Zgagacz, 2004). This is a complex issue, especially since science
teacher practices can be influenced by a number of contextual factors (National Research Council [NRC], 2003). Unfortunately, few empirical studies have focused on the relationship between contextual factors and teaching orientations (e.g. Friedrichsen & Dana, 2003; Nargund-Joshi, 2012; Ramnarain et al., 2016). However, improving teacher practice begins with understanding their orientations. Ausubel’s rule is relevant: “If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly” (Ausubel, 1968).

I highlight these gaps in the literature to investigate middle school science teachers’ teaching orientations, in light of the relationship between science concepts, related teaching instructional approaches, and the role of external contextual factors. I address these relationships through the use of orientation profiles from the Pedagogy of Science Teaching Test (POSTT) instrument (Cobern et al., 2014). Instead of Magnusson et al. (1999)’s nine orientations (academic rigor, didactic, active driven, process, project based science, conceptual change, inquiry, guided inquiry, discovery), I reference the science teaching orientation spectrum (Table 1.1) for identifying science teaching orientations in this study. Classifying teaching orientations under four specific orientations (see Table 1.1) and two instructional approaches (direct instruction, inquiry instruction) allowed me to compare and contrast middle school science teachers’ orientations. Thus, a narrowed orientation range provided better clarification to the complexity and nature of teachers’ orientations.

The teaching orientation spectrum of the POSTT instrument also allowed me to elicit teachers’ orientations and underlying beliefs about science teaching and learning specific to Turkish middle school science teachers. The POSTT instrument has potential for transadaptation
to different languages and cultures (e.g., Asrin, 2014). Given that new Turkish education policy calls for greater inquiry instruction, learning more about in-service teacher pedagogical orientations can inform teacher development efforts directed at promoting science inquiry instruction. Therefore, using the POSTT assessment instrument helped to determine teaching orientations of Turkish middle school science teachers.

Table 1.1

*Science Teaching Orientation Spectrum*

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Didactic Direct (DD)</td>
<td>The teacher presents the science concept or principle directly and explains it. The teacher illustrates with an example or demonstration. No student activities, but the teacher takes student questions and answers them or clarifies.</td>
</tr>
<tr>
<td>Active Direct (AD)</td>
<td>Same as the direct exposition above initially, but this is followed by a student activity designed to demonstrate the presented science concept.</td>
</tr>
<tr>
<td>Guided Inquiry (GI)</td>
<td>Topics are approached by student exploration of a phenomenon or idea, with the teacher guiding them toward the desired science concept or principle arising from the activity. The teacher may explain further and give examples to consolidate. Questions are dealt with by discussion.</td>
</tr>
<tr>
<td>Open Inquiry (OI)</td>
<td>Instruction is minimally guided by the teacher. Students are free to explore a phenomenon or idea in any way they wish, and to devise ways of doing so.</td>
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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Effective teacher preparation for the development of teachers’ science teaching orientations is fundamental. Therefore, it is necessary to provide sufficient explanation and understanding about how science teachers translate their knowledge into classroom practice. Unfortunately, this is a difficult task because various factors influence both the development and implementation of pedagogical orientations towards science teaching.

My interest in part is to clarify pedagogical orientations of science teachers in Turkey. Currently, Turkish in-service middle school teachers are moving more towards inquiry instruction as motivated by Turkish curriculum reforms. I am interested to what extent teachers are prepared for this change and how well they understand the reasons for adopting inquiry instruction instructional approaches.

Therefore, this literature review is motivated by an interest in effective science teacher preparation and science teacher professional development. Middle school science teachers are specifically of interest though the literature review addresses all grade levels. While there are many things the teacher must know in order to be effective, this review focuses on the effective teaching of science concepts. In order to do research in the area of concept instruction, I have identified three specific domains to consider: science teaching orientations, science instructional
approaches and characteristics, and contextual factors effecting teachers’ in practice (see Figure 2.1).

Research on the relationship across all three domains rarely takes place in the literature. Therefore, one primary goal of this literature review is to clarify what is known about the research within each of these separate domains and provide a new perspective on how all three could be combined to advance better understanding about middle school science teachers’ pedagogical orientations toward concept instruction.

Each section of the review critically reviews the literature pertaining to that domain and ends with a summary of the main ideas pertaining to that domain. Finally, the literature review is concluded with a synthesis of the three sections (domains) of research and suggests future research possibilities.

*Figure 2.1. Structure of the Literature Domains*
2.2. Domain #1: Science Teaching Orientations

For clarification, we should at first think about teaching orientations in simple ways. In general, orientation refers to the relative position of something or someone. When applying this view to education, we could say teaching orientation refers to the relative position that a teacher takes toward instruction, and that orientation may or may not reflect best teaching practices. Teacher orientation influences a teacher’s disposition toward how best to teach. A teacher’s orientation and disposition, however, have to be translated into practice; and a teacher may be disposed to teach one way but in practice teach differently. Teachers can thus have both pedagogical and instructional orientations; that is, they may be disposed to teach one way (pedagogical orientation) but in practice act differently (instructional orientation).

Science teaching orientations of teachers begins with when they bring their preexisting knowledge and beliefs about teaching into their teacher education programs (Borko & Putnam, 1996; Kagan, 1992). Their orientations are modified through the courses they take as undergraduate students. Finally, orientations towards science teaching take a more final shape with teaching experience as novice science teachers. Contrary to expectations, understanding and building of pre- and in-service science teachers’ orientations towards science teaching is a complex and time-consuming issue (Friedrichsen, 2003). There are also significant gaps in the literature having to do with the assessment of teaching orientations. Therefore, we should consider numerous elements for explicitly examining teachers’ orientations.

The first domain of the literature review addresses the notion of science teaching orientations, specifically focusing on the connection between orientations and teachers’ knowledge of instructional strategies.
2.2.1 Definition of science teaching orientations

Many researchers and educators indicate that there is ambiguity in the literature regarding categorizing different teaching orientations in science education (Friedrichsen, 2003; Abell, 2007; Nargund-Joshi, 2012). Various researchers have attempted to distinguish between various teaching orientations (e.g., Magnusson et al, 1999; Friedrichsen & Dana, 2005; Friedrichsen et al., 2011; Boesdorfer & Lorsbach, 2014; Boesdorfer, 2015, Kind, 2016). This section focuses on efforts to define and categorize various orientations.

Anderson and Smith (1987) were among the first users of the term *orientations* in science education and they defined it as “teachers’ general patterns of thought and behavior related to science teaching and learning” (p. 99). They suggested that what a teacher thinks and believes about instruction will influence the teacher’s classroom behavior. Grossman (1990) added that orientations are “conceptions of teaching” or "knowledge and beliefs about the purposes for teaching a subject at different grade levels" (p.8). She argued that orientation has an essential role with respect to how novice teachers are successfully able to improve their inappropriate decision-making skills. Improving teacher beliefs about the goals for teaching will improve instructional choices, including classroom materials, assignments, and assessment of students.

Magnusson et al. (1999) integrated teaching orientations within his model of pedagogical content knowledge (PCK). In the Magnusson et al. model (1999), one of the important components of a teaching orientation is beliefs about science teaching and learning that undergird knowledge of instructional strategies, or PCK (Demirdogen, 2016, p.509). According to the model, knowledge and beliefs of science teachers influence teacher instructional choices.
having to do with the organization of activities, the content of student assignments, the use of textbooks and curricular materials, and the evaluation of students’ learning.

Friedrichsen and Dana (2003) noted that the current literature did not provide a clear description of what is meant by teaching orientations. They retained the Magnusson et al. inclusion of science teaching orientations as a critical component of PCK. However, they expanded the Magnusson et al. PCK model to include an explanation of “teachers’ knowledge and beliefs about the purposes and goals for teaching science at a particular grade level” (Magnusson et al., 1999, p. 97).

Later, Roehring and Luft (2004) used orientation in reference to teachers' professional thoughts, belief, and knowledge for teaching science. Abell (2007) summarized the importance of science teaching orientations as a main component of PCK that included pre- and in-service teacher’s knowledge, beliefs, and practice. As summed up by Abell (2007), teaching orientation in science can involve many things including specific reference to pedagogical orientation or instructional orientation (Cobern et al., 2014; Ramnarain & Schuster, 2014; Ramnarain et al., 2016). It is expected that science teachers will develop an orientation toward science teaching practice (Law, 2009), where orientation is sometimes referred to has an instructional orientation and sometimes as a pedagogical orientation. The meanings of the two are similar in the literature. Sometimes, however, pedagogical orientation is used in reference to instructional approaches teachers would take if not constrained by other factors; whereas, instructional orientation is often used in reference to teachers’ actual practice. For the purposes of my research, I use pedagogical orientation and instructional orientation in this way.
Considering the above, this domain of the literature review focuses on pedagogical orientations, what science teachers are likely to do in the classroom or school environment, and what factors influence teaching practices.

2.2.2 Common teaching orientations models and assessment instruments in science education

Teaching orientations is a broad issue and teachers can be oriented in many different ways (Anderson and Smith, 1987; Magnusson et al., 1999; Friedrichsen, 2011) and multiple orientations are possible (Friedrichsen & Dana, 2003). Anderson and Smith (1987) introduced the idea of orientations to categorize four different approaches to science teaching: didactic teaching, activity-driven teaching, discovery teaching, and conceptual change teaching. They emphasized that an orientation characterizes a general perspective about teaching and learning science with respect to certain assumptions. Thus, a definition of science teaching orientations can be based on teaching goals, characteristics of instruction, and views of science (Kind, 2016). Magnusson et al. expanded the Anderson and Smith (1987) list of orientations to teaching science by adding: process, academic rigor, project-based, inquiry (as open inquiry), and guided inquiry orientations. Although the Magnusson et al. (1999) PCK model is well-accepted by science researchers and educators, it can sometimes be confusing as to what the orientations actually are (Friedrichsen et al., 2011). Friedrichsen et al. claim that there are two main problems regarding Magnusson et al. proposed orientations. First, they believe that “the few empirical studies cited that included teachers’ beliefs related to their planning and teaching science were based on a small number of cases, primarily of elementary teachers; middle and secondary
science teachers were underrepresented in the studies cited” (p. 365). They seem to be problematic this issue because these teaching orientation categories are shown as if they are developed from studies of elementary teachers will apply to secondary science teachers. Second, Friedrichsen et al. assert that “many of the orientations to teaching science were based on curriculum orientations instead of empirical studies of the goals of teachers” (p. 366). Therefore, PCK researchers sometimes misinterpreted or even misused this list of science teaching orientations.

With previous orientation models in mind, Cobern et al. (2014) developed a more specific orientation model (“Science Teaching Orientation Spectrum”) that ranges from direct to inquiry instructional approaches. They based the structure of their science teaching orientation scale on the contrasting perspectives of “Science presented as a known product” (Ready-made-science) and “Science as produced through inquiry” (Science-in-the-making). Correspondingly, Cobern et al. developed the Pedagogy of Science Teaching Test (POSTT) instrument to assess science teachers’ pedagogical orientations profiles. The instrument involves four common teaching orientations (didactic direct, active direct, guided inquiry, and open inquiry) making it more specific than the orientation model proposed by Magnusson et al. (1999) that also included process, academic rigor, conceptual change, and project-based science. Similarly, Nargund-Joshi (2012) reduced “the goals of different orientations to teaching science” components of the Magnusson et al. (1999) model to two orientation categories: teacher-centered orientations (didactic, academic rigor) and student-centered orientations (process, activity-driven, discovery, conceptual-change, project-based, and guided inquiry).

From a different perspective, Lee and Luft (2008) organized teaching orientations with respect to domain-oriented (integrative) orientation and topic-oriented (transformative)
orientation models. The integrative model includes Shulman’s three knowledge of domains subject matter, pedagogy, and context knowledge as distinct components associated with PCK. It is a question; however, whether having independent knowledge about orientation components can lead to integration with PCK. On the other hand, the transformative model integrates content and pedagogy to be translated into classroom practice. Marks (1990) essentially concurred that it is impossible to distinguish PCK from either subject matter knowledge or general pedagogical knowledge. Many educators and researchers claim that novice teachers choose one domain rather than drawing concurrently from all domains, unlike expert teachers (Ball & Bass, 2000; Davis, 2003; Grossman, 1990). As a result, Lee and Luft (2008) claim that the integrative model could portray the PCK of novice teachers, and the transformative model could portray the PCK of experienced teachers.

Loughran et al. (2004) similarly investigated the topic-specific nature of teaching orientations. He and his colleagues developed the Content Representations (CoRes) and Pedagogical and Professional-experience Repertoires (PaP-eRs) as assessment instruments for determining science teaching orientation. These instruments have been used with pre-service and in-service teachers where the subjects prepared specific science content lesson plans and then were observed doing micro-teaching events (Loughran et al., 2006; Hume & Berry, 2011).

To identify pre-service teachers’ and experienced teachers’ orientations, Friedrichsen and Dana (2003) collected data from various sources, such as, classroom observations, examination of teaching artifacts, and semi-structured interviews (peer interview approach and modified interview approach). Interviews with pre-service teachers and experienced teachers were particularly important for deeper investigation and an advancement over the Magnusson et al. (1999) approach. Magnusson et al. (1999) drew upon classroom observations and researcher
inferences from those observations, but they did not include interviews with teachers to explore teachers’ purposes and goals teaching science (Friedrichsen, 2002). Friedrichsen and Dana (2003) drew on the power of interviews for clarifying teachers’ orientations and reasoning towards science teaching. They argued that for the study of teacher orientations it is necessary to obtain demographic information relevant to pre-/in-service teachers, such as years of teaching experience and background knowledge.

Friedrichsen and Dana (2003) attempted to identify pre-service elementary/middle school teachers’ orientations and compare it with experienced elementary/middle school teachers’ orientations by using an unusual research tool (card-sorting task). The card-sorting task was originally designed as a research tool for eliciting pre- and practicing teachers’ knowledge and beliefs about teaching and learning. Friedrichsen and Dana (2003) also applied a different card-sorting task to examine teaching orientations of the participants according to their thoughts about various scenarios. The card-sort scenarios were written using four, common PCK components: knowledge of science curricula, knowledge of students’ understanding of science, knowledge of instructional strategies, and knowledge of assessment of scientific literacy. The card-sorting task tool was applied to participants separately in respect to their targeted grade levels as elementary and middle school. Two science card scenario sets were prepared. For example:

*Elementary School Pre-service Science Teachers Science Card Scenarios (18 scenarios)*

Scenario #10: You, as a teacher, set up learning centers for a unit on Newton’s Laws of Motion. Using resource books from your school’s library, you select a variety of fun, easy-to-do activities.
Scenario #12: You, as a teacher, set up a “Sink or Float” learning center in one corner of the room. On a weekly basis, you change the materials available at this center (Friedrichsen and Dana 2003, p.307).

Middle School Pre-service Science Teachers Science Card Scenarios (20 scenarios)

Scenario #5: To help your students understand arthropod characteristics, you organize a series of stations, with each station containing representatives from a different class of arthropods.

Scenario #10: You, as a teacher, begin a pendulum unit by giving students strings and weights. By letting the students explore on their own, they will be able to discover which variable (length of string or mass) affects the number of swings per minute (Friedrichsen and Dana, 2003, p.308).

Friedrichsen and Dana (2003) found that participants’ science teaching practices were more complex than what they expected from the literature. They then focused on teacher comments during the card sorting, rather than how the teachers sorted particular cards. This qualitative approach provided better understanding of the participants’ science teaching practices. Friedrichsen and Dana (2003) noted that experienced teachers responded differently to the card sort than prospective teachers. Where prospective teachers tended not to ask additional questions about the scenarios (for example about the context of instruction involved in the scenarios), experienced teachers tended to infer contextual clues as they considered each scenario.

Friedrichsen et al. (2011) addressed the interaction between many ways of science teaching orientations and PCK components based on Magnusson et al. (1999) model. They examined science teaching orientations, broadly, through theoretical research. Friedrichsen et al.
provide specific references for explanation of how these orientations were examined. They proposed that teaching orientations involve the following three dimensions: beliefs about the goals or purposes of science teaching, beliefs about the nature of science and beliefs about science teaching and learning. Friedrichsen et al. (2011) subsequently summarized the problems of teaching orientation research under the four issues:

1. There is insufficient clarification about the definition of orientation.
2. The connection between the components of PCK and role of orientations hasn’t been clearly explained.
3. Researchers used a general list of nine orientations but without focusing on understanding the complex nature of orientations.
4. Because of the complex nature of PCK and orientations, researchers avoid handling all components of PCK and orientations at one time.

Regarding the first category, I also found that the definitions for science teaching orientations found in the literature are limited and unclear because there are few empirical studies to clarify types of teaching orientations. This problem results from the complex nature of teaching orientations that have different types. It is challenging to identify a teacher’s orientation with specific orientation (Nargund-Joshi, 2012). Even though Magnusson et al. (1999) indicate that teachers are able to hold multiple orientations, the researchers state one of these orientations (Friedrichsen, 2011). For instance, Schwartz and Gwekwerere (2007) noted, “…their prospective teachers held elements of multiple orientations as evidenced by their lesson plans, but the researchers chose to report only the orientation they thought was dominant.”

Regarding the second and third categories, many researchers accept teaching orientations as a component of PCK, but they fail to focus on the relationship between PCK and its
components such as teaching orientations. I strongly support Friedrichsen et al. (2011) on this point; more attention needs to be paid to the reciprocal relationship involving teaching orientations and PCK. Regarding the forth category, Friedrichsen et al. (2011) noted that the Magnusson et al. (1999) model (and its variants) do not deal with the interrelations amongst PCK components. They make an important point; however, category four identifies a significant difficulty for conducting PCK research: it is very difficult to handle the relation of teaching orientations towards science with all the components together. Friedrichsen et al. suggested that to elicit all dimensions new instruments were needed. Given the compound nature of PCK, and that science teaching orientation is an aspect of that compound, I propose to follow the guidance of Friedrichsen et al. (2011) and work specifically with the idea of science teaching orientations. It is also of concern that other researchers have examined science teaching orientations to using different terms to define what appears to be similar constructs (Abell, 2007). Following Cobern et al. (2014), I have chosen to specifically use teaching orientations in reference to pedagogical orientations ranging from direct teaching (teacher-based) to inquiry-based teaching (student-based) for reasons discussed in Domain #2.

2.2.3 Translating science teaching orientations into practice

Teachers can have both pedagogical and instructional orientations; that is, what they claim to believe about teaching may be different from their behavior in the classroom. It is important to figure out how science teachers actually teach because once in the classroom they may not actually teach as they are inclined to do. Teachers sometimes face problems about translating their orientations for teaching science into actual practice (Friedrichsen & Dana,
2003; Volkmann & Zgagacz, 2004). This is a complex issue given that science teacher practice can be influenced by a number of contextual factors (National Research Council [NRC], 2003). Unfortunately, few empirical studies have focused on the relationship between contextual factors and teaching orientations (e.g., Friedrichsen & Dana, 2003; Nargund-Joshi, 2012; Ramnarain et al., 2016); moreover, the matter is further complicated by the existence of both internal and external factors that can influence a teacher. Internal factors are factors personal to the teacher such as self-efficacy beliefs. External factors are not personal to the teacher but come from outside entities such as the school, curriculum and classroom environments.

Teaching orientations can be shaped by many factors, including content knowledge, overall interest in the content and general personality. For instance, middle school teachers could like some areas of science but not all areas and not all at the same level. Middle school teachers teaching general science may, for example, like biology more than physics. Teachers’ interests in one area of science or another could easily influence their teaching orientations toward teaching each. Or, as a different example, a teacher who is authoritarian may know how to apply inquiry instructional approaches, but would prefer not to because they would rather be in control of the classroom.

There are also other internal factors that can impact teaching orientations. Teachers’ attitude about education includes their beliefs about schooling, teaching, learning, and students. Moreover, teachers have beliefs concerning matters beyond their profession and these certainly influence teachers’ practice in the classroom. For this reason, teachers should be clear about the beliefs they hold relevant to the educational process. Pajares (1992) summarizes that “a strong relationship between teachers’ educational beliefs and their planning, instructional decisions, and classroom practices” exists (p. 326).
Many researchers and educators argue that teachers’ beliefs and practices should not be examined out of context (Mansour, 2009). One context factor is belief about epistemology (or the nature of knowledge). Epistemological belief can be an important teacher context factor (Bahcivan, 2014). Instructional choices of teachers align with their epistemological beliefs (Jones & Carter, 2007). For example, a teacher who has a constructivist view of knowledge is more likely to choose to use some form of inquiry-based instruction. Teachers’ beliefs would be considered part of their orientation toward science teaching within a broad construct of PCK (Boesdorfer, 2015). Many empirical studies have indicated the significance of understanding teachers’ beliefs (Calderhead, 1996; Nespor, 1987; Pajares, 1992, Jones & Carter, 2007), but only a few have examined the connections between teacher beliefs about teaching, knowledge of teaching, and how these translate into teacher practice - and even fewer yet have explored the potential influence of contextual factors on these connections (Abell, 2007; Nargund-Joshi & Liu, 2013).

For instance, Roehring and Luft (2004) emphasize the importance of how teachers’ beliefs effect their pedagogical decisions. They investigated the effect of teachers’ knowledge and beliefs about the purpose and goals for teaching science at a particular grade level. Fourteen secondary science teachers, who had one to three years teaching experience, participated in a year-long study. During this period, monthly workshops were facilitated by a university science educator, mentor teachers, and graduate assistants. Beginning teachers, who also participated in online communications, were visited in their class monthly by project staff. The participating teachers also attended a national science education conference to acquire additional teaching resources. The researchers categorized teachers as "Inquiry Teachers," "Process-Oriented Teachers," and "Traditional Teachers." Based on the findings, teachers with an inquiry
orientation held student-centered beliefs and displayed guided inquiry instructional strategies. Teachers with a process orientation taught predominantly using activities and laboratories. Teachers with a traditional orientation believed that "There is stuff they just need to be told!" (p. 16) and emphasized providing detailed information in a lecture format. The researchers concluded that teacher beliefs - especially epistemological beliefs - should be considered as a filter for understanding PCK and teaching orientations toward science education.

The emotional perspective of becoming a teacher must also be given attention. While this may be difficult to generalize, it is possible to consider evaluations of teachers’ self-confidence and efficacy, as well as to analyze belief systems that may influence the classroom in practice (Park & Oliver, 2008). Researchers posit that change in teachers’ self-efficacy (also an internal factor) is another important step in shaping teachers’ instructional practices (Sandholtz & Ringstaff, 2014). Pajares (1992) implicitly describes self-efficacy under the notion of beliefs as being about confidence to perform specific tasks. Bandura (1997) introduced the notion of self-efficacy and emphasized that it not only influences teachers’ activity choices but also influences how much effort is expended on activities, and how long a teacher persists with an activity. Teachers, for example, who do not anticipate being successful, likely make less effort during preparation and instruction and give up more quickly in the face of difficulty (Tschannen-Moran & Hoy, 2007).

2.2.4 The relation between PCK and science teaching orientations

While all these factors, and likely many others, influence orientations towards teaching, my particular interest is specifically in PCK. Science teaching orientations can involve many
different things, but the science education literature focuses more on teachers’ PCK and within PCK is orientation toward instructional strategies (Abell, 2007). For instance, if the teachers do not know anything at all about inquiry instruction then it is unlikely they will be oriented that way. At this point, I begin with providing an overview of how the concept of PCK is a complex notion, and attempt to clarify its relationship with science teaching orientations.

We are briefly able to handle almost all the studies relevant to PCK by collecting them under two specific categories. These are descriptive studies and studies relevant to the assessment of PCK. Descriptive studies generally focus on creating a model or providing definitions about PCK. On the other hand, PCK assessment studies generally focus on developing a validated assessment instrument for the evaluation of existing PCK and better understanding of PCK improvement. There are more descriptive studies than assessment studies, and thus there is definitely a gap in the literature. It is hard to determine pre- or in-service teachers’ PCK because there are many domains which should be considered. However, there are still a few assessment instruments which are also related with teaching orientations and particularly provide some results, such as the card-sorting task (Friedrichsen & Dana, 2003), CoRes and PaP-eRs (Loughran et al., 2006), and POSTT (Cobern et al., 2014).

Shulman redefines knowledge of science teachers for teaching science in light of knowledge of science learners, curriculum, instruction, and assessment issues, relating all with science teaching orientations (Abell et al., 2010). It is clear that PCK theory is broad, but it has been briefly described as a way of knowing that is unique to teachers whereby they take an aspect of the subject matter and “transform their understanding of it into instruction that their students can comprehend” (Shulman, 1986b, p.8). In considering PCK I respectively go to

When Shulman (1986b) purposed the concept of PCK, he was arguing that pedagogy should be specific to content. In order to build teacher effectiveness, one needs to understand different strategies necessary for teaching specific types of content. Shulman states the absence of subject matter for the study of teaching is what the researchers and policymakers are missing. He asked whether there were pedagogies relevant to science as content when teaching science. PCK has a tacit nature because it is embedded in a specific context or subject matter. Therefore, some researchers define PCK as a ‘hidden’ or ‘intangible’ concept (Cochran-Smith & Lytle, 1999; Kind, 2009).

In his empirical research, for example, Hashweh (1987) investigated how three physics and three biology teachers’ science knowledge impacted their teaching. All six teachers’ subject matter knowledge in both biology and physics was examined and then they planned an instructional unit in both areas. The findings showed that teachers teaching within their field knew what preconceptions students would have or what science concepts would be difficult for students, and were able to successfully use a variety of analogies, examples, demonstrations, and model in their own field. When teaching outside their field, however, the teachers exhibited less understanding of the information and were less able to address students’ misconceptions. The teachers from both fields used the same number of examples and analogies for both fields; nevertheless the teachers were more accurate and relevant when teaching within their field of expertise. It is still difficult to generalize the connection with teaching knowledge and content knowledge, but many of the studies like this one indicate that PCK is positively correlated with subject matter knowledge (Grossman, 1990).
For answering the questions about how subject matter is transformed into instruction and how lesson content relates to students’ knowledge and ideas, Shulman proposed three categories of content knowledge: subject matter content knowledge, pedagogical content knowledge, and curricular knowledge (lateral & vertical). Shulman (1986b, 1987) believed that PCK plays an important role because it identifies the distinctive bodies of knowledge for teaching. PCK represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. Shulman pointed out that PCK gathers all three categories under a topic, and he tried to attract educators’ and researchers’ attention to the questions, like what teachers need to provide effective teaching of specific topics and how teachers successfully handle students’ conceptions and preconceptions by considering their grade level and background knowledge for these topics.

At about the same time, Anderson and Smith (1987) similarly argued about science teaching orientations and PCK, but used different explanations. They emphasized the importance of the combination of teacher’s cognition and action, thus they similarly discussed about content knowledge for teaching as PCK. Anderson and Smith (1987) also mentioned teaching orientations implicitly, referring to it as “teaching behavior” throughout their study. Many researchers have since added new categories the PCK model (Grossman, 1990; Magnusson et al., 1999).

Grossman (1990) extended Shulman’s work on PCK within the field of literacy. Her model proposed that PCK both influences and is influenced by the teacher’s subject matter knowledge (what teachers need to know about the specific topic), general pedagogical knowledge (principles and strategies for classroom organization and management) and
knowledge of context (community, district, school) within which they are teaching. Grossman (1990) asserted that there is a reciprocal relation between PCK and these three domains. She specifically focused on subject matter, using four overarching components to describe PCK:

(a) Knowledge and beliefs about the purposes for teaching a subject at different grade levels, and how these affect the teachers’ purposes for teaching a particular subject at a particular grade level;

(b) Knowledge of students’ understanding, conceptions, and misconceptions of particular topics in a subject matter, referring to the importance of teachers understanding what students already know in order to give them the right kind of examples;

(c) Knowledge of curriculum materials available for teaching a particular subject matter, as well as knowledge of both the horizontal and vertical curricula of a subject, that is, knowledge of which topics are typically addressed in a particular grade and how various strands within a particular grade level as well as within a curriculum can be arranged; and

(d) Knowledge of instructional strategies and representations for teaching. Grossman especially indicated that the component of “knowledge and beliefs about the purposes for teaching a subject at different grade levels” shapes the other overarching components.

Grossman (1990) claimed PCK was a conceptual map for determining how to organize textbooks, classroom objectives, assignments, and evaluation of students” (p.86). In parallel to this thought, she believed that teaching orientations also serve as a "conceptual map" for making instructional decisions like daily objectives, the content of student assignments, the use of textbooks and other curricular materials, and the evaluation of student learning (Nargund-Joshi, 2012).
From a different perspective, Cochran et al. (1993) extended Shulman’s ideas about PCK by proposing a different model based on constructivist learning approaches. They distinguished between knowledge and knowing, and arguing that the term ‘knowledge’ refers to something that is not in a stable position and PCK is thus dynamic in nature. Therefore, they preferred to use the term PCK to mean ‘Pedagogical Content Knowing.’ Cochran et al. (1993) further described PCK as “a teacher’s integrated understanding of four components of pedagogy, subject matter content, student characteristics, and the environmental context of learning” (p. 266), and emphasized the integrated structure of PCK. They also agreed that teacher training and teachers’ understandings of their students influences effect teaching practice.


According to Gess-Newsome (1999), integrative model represents the knowledge about PCK components (subject matter, pedagogy, and context) independently to examine a teacher’s ability to integrate these components in the act of teaching. In other word, Fernandez-Balboa and Stiehl (1995) defined the integrative model process when developing any of these PCK components would develop PCK as a whole. On the other hand, the transformative model refers synthesized these knowledge base for teaching. According to this perspective, content and pedagogy are integrated and transformed into classroom practice. Many researchers advised that
novice teachers tend to rely more heavily on one domain of knowledge rather than drawing simultaneously from all domains, as is the case with an expert teacher (Ball & Bass, 2000; Davis, 2003; Grossman, 1990). Therefore, the integrative model probably reveals the PCK of novice teachers; however, the transformative model is fit to represent the PCK of experienced teachers Lee and Luft (2008).

Lee and Luft (2008) offered yet another model of PCK. Their model consists of seven components: knowledge of science, knowledge of goals, knowledge of students, knowledge of curriculum organization, knowledge of teaching, knowledge of assessment, knowledge of resources. There are specific elements within each component. For instance, the knowledge of science component includes science content, scientific practice, the nature of science, and scientific process elements and the knowledge of students component includes different levels, needs, interests, prior knowledge, ability, learning difficulties, and misconceptions elements.

As implied by these studies, even though many researchers have investigated the notion of PCK, there is still no commonly accepted conceptualization of PCK, but there are some popular models such as Magnusson et al. (1999). Nevertheless, all researchers benefit from the structure of PCK by considering teachers’ knowledge of representations of subject matter, and their knowledge of learners’ conceptions and content-related difficulties. They also recognize that PCK is also specifically concerned with the teaching of specific content.

For example, Boesdorfer (2015), using the Magnusson et al. (1999) model, explored the relationship between teacher choice of instructional strategies and their orientation toward science teaching, expecting PCK and teaching orientations to be related. Boesdorfer (2015) tested his hypothesis by conducting a comparative case study of two secondary chemistry teachers. On other factors both teachers were about equal. For instance, they had similar
demographic information, contextual factors (same area, similar class size, and so on), high teaching experiences and they come from same field (chemistry).

The study effectively correlated classroom observations and documents with interviews for the purpose of elucidating teaching orientations with actual teaching practice. For instance, the first teacher’s orientation toward science teaching included traditional, teacher-centered beliefs about teaching and learning science. This teacher generally used demonstrations and worked problems herself in front of the class. Students never worked problems on their own or explained how they got answers to questions during whole class time. The other teacher’s orientation toward science teaching included student-centered beliefs about teaching and learning science. Boesdorfer (2015) believed that the students were responsible for their learning and the teacher rarely answered their questions. In the classroom, she posed thinking questions and used class or peer discussions. Results of the study indicate that the teachers’ actual instructional practices reflected their orientations toward science teaching. This study is a good sample presenting the interaction between science teaching orientation types and preferred instructional strategies. The findings suggest that studying teacher orientation can be important even when it is not possible to study their actual practice.

It is generally agreed that PCK is embedded in classroom practice and it influences teacher practice. The literature suggests that prospective and novice teachers have partial and superficial levels of PCK; hence teachers need to improve their PCK through new teaching and learning experiences. This implication evidences that teaching orientations and PCK follow similar development processes.
2.2.5 Summary

Many researchers use the Magnusson et al. (1999) model, or some variant of it, and they emphasize that science teaching orientation is one of the important components of PCK. They also note, however, the lack of clarity with regard to defining PCK and the relationship amongst PCK components (e.g., Friedrichsen et al., 2011; Boesdorfer, 2015). There are even those researchers who say that teachers can have multiple orientations (Nargund-Joshi, 2012), but it is not clear what that could mean. Unfortunately, the interrelationships amongst PCK components are complex and difficult. Recognizing this complexity, my research interest focused on one PCK component that is significantly relevant to instructional strategies. My interest lies in identifying teachers’ science pedagogical orientations and the reasons they have for those orientations. One strong suggestion from the research literature is that there is a link between teaching orientation and instructional practices of the teacher. There is evidence that the instructional strategy preferences of teachers, that is, their teaching orientations, reflect their actual teaching practices (Magnusson et al, 1999; Friedrichsen et al., 2011; Boesdorfer, 2015). That linkage suggests that it can be important to investigate teachers’ science teaching orientations.

Orientation toward science teaching practice, however, requires knowledge of instructional approaches. Hence, the next section (Domain #2) reviews the various approaches to science teaching that would inform a teacher’s orientation to particular instructional practices.
2.3 Domain #2: Science Instructional Approaches and Characteristics

One of the most important purposes of professional development is for teachers to improve their ability to organize and implement effective instruction that leads to students’ learning of science concepts. Thus students can increase their achievement toward scientific literacy (Fennema et al., 1996; Desimone et al., 2002). Science teachers should have a broad repertoire of instructional strategies that engage students in multiple ways. Depending on the goals of a specific lesson, one or several instructional strategies may be appropriate (NRC, 1996).

This section clarifies types of instructional approaches by considering common and effective science instructional approaches. The literature also focuses on the evidence of why these approaches are important and how these approaches are characterized.

2.3.1 Common learning approaches

It is important to consider the background to various instructional approaches. The theoretical and conceptual structure of this section focuses on rote vis-à-vis meaningful learning approaches and traditional vis-à-vis constructivist approaches. In the current literature, the rote/meaningful learning dichotomy is reinterpreted as a direct instruction/inquiry instruction dichotomy (Cobern et al., 2014).
2.3.1.1 Rote/Meaningful learning

With respect to instruction the literature in science education has different things to say, but all instructional strategies are intended to lead to meaningful learning (NGSS, 2013). Ausubel proposed the theory of meaningful learning that occurs when learners experience conceptual change (Ausubel, 1963 & 1968; Ausubel et al., 1986). Meaningful learning results from a learner’s cognitive engagement such that new knowledge becomes integrated within the learner’s conceptual schema (Ausubel et al., 1986; Driscoll, 2005) - new knowledge is integrated into and reorganizes the learner’s existing knowledge. Three specific conditions need to be provided in order to generate meaningful learning (Ausubel 1963; Ausubel et al., 1986; Driscoll, 2005):

1) A student must have some relevant prior knowledge to which the new knowledge can be related in a non-arbitrary manner.
2) The material to be learned must be meaningful in and of itself; that is, it must contain important concepts and propositions relatable to existing knowledge.
3) A student must consciously choose to non-arbitrarily incorporate this meaningful material into his/her existing knowledge.

In contrast to meaningful learning, rote learning can be characterized as (Driscoll, 2005):

1) Arbitrary, verbatim, non-substantive incorporation of new knowledge into cognitive structure.
2) No affective commitment to link new knowledge to prior learning.
3) No effort to integrate new knowledge with existing concepts in cognitive structure.
4) Learning not related to experience with events or objects.
Ausubel (1961) highlighted two types of learning: reception and discovery learning. He defined reception learning as learning the content by being presented knowledge in its final form. On the other hand, Ausubel (1961) defined discovery learning as coming to new knowledge through experience.

According to Ausubel, there is more than one type of instructional approach that can lead to meaningful learning. These approaches can range from more direct instruction (reception learning) to more inquiry instruction (discovery learning), and thus teaching orientations can range from teacher-centered to student-centered.

2.3.1.2 Direct/Constructivist learning

Constructivist theory claims that the learners are able to construct the knowledge by relating new experience with their prior knowledge (Driscoll, 2005). Learners also often focus on individual thinking and learning (Bell et al., 2009). According to a constructivist perspective, learners are not blank papers waiting to be written on, but rather build up their own understanding of concepts and propositions. Ausubel’s view of meaningful learning is what constructivist learning yields (Bretz, 2001) though it is not only constructivist learning that yields meaningful learning. Novak (1993; 2010, p.18) states that “meaningful learning underlies the constructive integration of thinking, feeling, and acting, leading to human empowerment for commitment and responsibility.” Novak (1993) asserts that meaningful learning will only happen when the teacher provides students experiences to construct connected knowledge across the three domains above.
Bretz (2001), for example, noted that when students learn energy transformations, they need to read about the concepts (e.g., enthalpy and entropy). Then, they also need to design and carry out experiments in the laboratory (e.g., combustion of foods with varying fat contents) which allows them to connect these abstract concepts to choices they need to integrate with their daily lives (feeling and empowerment).

In contrast to constructivist learning, traditional learning is typically thought of as a teacher-centered learning process leading to rote learning, but this view is problematic. The term ‘traditional’ has come to have many different meanings from past to present. On the other hand, even though a teacher may have the highest input in the learning process, students are still a part of that process. Using the term ‘direct’ could be better than using the term ‘traditional’ for clarifying this approach. Critiquing direct instruction, Tynjala (1999, p. 359) states that knowledge learned by direct instruction “can be used in educational settings such as preparing for tests and examinations,” but perhaps “cannot be transferred into real life situations.” In addition, using common forms of examinations often leads students to adopt a surface approach to learning and studying- memorizing the material instead of trying to understand it (Biggs, 1996; Entwistle & Entwistle, 1991 & 1992; Entwistle et al., 1993).

2.3.2 Instructional strategies and approaches

The notion of instructional approaches has appeared in education literature for a long time. Instructional approaches are described as any type of method or tool such as models, graphs, analogies, diagrams, pictures, simulations, equations for representing knowledge and improving students’ understanding of concepts in science (Treagust, 2007; Boesdorfer, 2015).
Teachers benefit from different instructional approaches in the classroom, whether these are hands-on classroom activities, laboratory activities, or inquiry-oriented teaching. Briefly, these methods and strategies range from more teacher-centered (lecture, illustration, demonstration, etc.) to more student-centered (activities, examples, models, investigations, think/pair/share, etc.).

Demonstrations are an example of an instructional approach that has been popular for a very long time, and teachers often emphasize their essential role in the learning science (Hofstein & Lunetta, 2004). This strategy is preferred by teachers because it is a less expensive and a safer way of providing students with laboratory experiences. Under a direct-instruction orientation, teachers use demonstrations to enhance students’ science understanding of concepts but can limit the application of students’ imagination that hands-on activities can provide. Under an inquiry-instruction orientation, the teacher is less a presenter as a mediator of student learning and an interpreter of the science content being demonstrated (Watson, 2000).

Another frequently preferred instructional strategy by teachers is classroom or teacher explanations, which are science teachers’ descriptions and explanations of scientific phenomena needed in order to contribute to students’ ability to make sense of the real world Horwood (1988). Treagust and Harrison (1999) emphasized that explanations should be used efficiently in the classroom. Successful teachers may “draw creative word pictures that both appeal to and inform a diverse group like a class of students” (p. 28). For this strategy, it is important how teachers verbally explain science concepts to students and how they teach students to verbalize their understanding. As Johnson-Laird (1983) said, “if you do not understand something, you cannot explain it” (p. 2). Teacher explanations can be used in both direct and inquiry-based orientations. Under a direct-instruction orientation, the teacher often provides explanations.
However, under an inquiry-instruction orientation, teachers use classroom explanations as a way to lead into more student-centered instruction.

*Cooperative Learning* is also a commonly used instructional strategy that encourages students to construct meaningful knowledge networks. Science teachers use this strategy to provide opportunities for students to engage in motivating and interactive cooperative learning activities (Treagust & Chittleborough, 2001). Various types of cooperative instructional methods have been used in science classrooms (Treagust (2007). One example is a method calls *Learning Together and Alone* (Johnson & Johnson (1975). In this method, the teacher should form heterogeneous student groups. The members of each group work together to achieve a specific goal. In the same time the students develop their personal and group learning skills.

One of the more student-centered instructional approach is use of *learning cycles* (Bybee, 1997), such as the Karplus and 5E learning cycles. The Karplus cycle is composed of exploration-invention-discovery and Karplus intended it to be an inquiry-instruction approach. Karplus and Thier (1967) define the cycle with three phases and explain that the “exploration phase provides students with the experience of the concept to be developed, such as the use of laboratory experiments, which involves deductive thought. Then, in the conceptual invention phase, the students and/or teacher develop the concept from the data through classroom discussion, which involves inductive thinking” (Treagust, 2007, p. 384-385). The 5E model is similar: engagement, exploration, explanation, elaboration, and evaluation. Each phase has different functions and help students to construct a better understanding of scientific knowledge.

Although both cooperative learning and learning cycle techniques seem more appropriate for an inquiry-instruction orientation, it is also possible to use these approaches with a direct-instruction orientation. How teachers lead and direct these activities determines which
orientation is involved. For instance, a direct-instruction teacher uses activities so that students can verify a concept. However, an inquiry-instruction teacher uses activities so that students are able to infer the concept from their findings. The difference is in how students come to a concept. In direct instruction the concept is presented by the teacher (or could be a textbook, video, or some other communication media) while with inquiry instruction students infer a concept from the findings of their activities.

Problem-based learning is another instructional strategy where students learn by solving problems (Woods, 1994). Problem-based learning can help students develop skills and confidence for problem solving. Teachers are able to use this strategy within both direct and inquiry-instruction orientations. The difference is that while the teacher who has a direct-instruction orientation leads the learning process with directions and summarizes the solution process for the students, the teacher who has an inquiry-instruction orientation allows the students to direct their own efforts at problem solving with minimum teacher guidance.

As a final example, Donovan et al. (1999, p.13) describe “a metacognitive approach to instruction” where teachers “help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them." Students are able to enhance their cognitive thinking abilities through metacognitive activities. Teaching techniques such as concept maps (Novak, 1990), predict-observe-explain tasks (White & Gunstone, 1992), personal logs, reflections, portfolios, and discussion have been effective on the development of metacognitive capabilities. Concept mapping is especially popular amongst teachers for the improvement of learning and teaching in science classrooms. This technique helps teachers as a learning strategy, as an instructional strategy, as a strategy for planning curriculum, and for
assessing students’ understanding of science concepts (McClure et al., 1999). Concept mapping strongly supports meaningful learning in that it helps develop cognitive structure.

### 2.3.4 Effective instructional approaches

According to *Ready, Set, Science!* (Michaels et al., 2007), there are four aspects of science that students need to learn: understanding scientific explanations, generating scientific evidence, reflecting on scientific knowledge, and participating productively in science. My literature review focuses on scientific explanations more than the other aspects because conceptual understanding is fundamental for achieving the other objectives (Cobern et al., 2014). Of course, fundamental for the effective teaching for conceptual understanding is a repertoire of instructional approaches. Therefore, teachers are responsible to find and apply effective instructional strategies and approaches. There are various instructional approaches and it is possible to sort them on a broad scale. The National Science Education Standards (NSES, 2000) claims that instructional approaches spread over a range from ‘direct’ instruction through different levels of inquiry to open discovery learning. Accordingly, K-12 in-service science teachers build up their science teaching orientations between teacher-centered and student-centered or direct to open discovery approaches (Schwartz et al., 2009). There are boundaries between possible instructional approaches and there are similarities.

According to Banilower et al. (2008), two views explicitly come to the forefront of the science education community. These are *traditional* science instruction and *reform* science instruction. Traditional instruction is identified as the teacher providing the information through lectures and readings. Students work individually when they practice problems or worksheets.
There could also be laboratory activities under the control of the teacher. On the other side, reform instruction is identified with students working in small groups to conduct an activity, gather data, and come to conclusions with respect to the concepts that were learned. Cobern et al. (2010) argue that educational and political policy makers have debated two instructional approaches for many decades: inquiry instruction and direct instruction. Similarly, Boesdorfer (2015) argues that instructional approaches range them from direct to constructivist (inquiry-based) or teacher-based to student-based approaches.

2.3.4.1 Direct instructional approach

There is a long history of science teachers using traditional (i.e., didactic) methods (Stake and Easley, 1978; Harms and Yager, 1981; Weiss, 1987). Even recently Banilower and Smith (2013) point out that non-inquiry instruction persists among teachers in the USA. The problem is that as typically used, direct instruction can lead to passive learning (Leone-Cross, 2013; Mervis, 2013). Direct instruction generally involves lecture, memorization, and cookbook laboratory work, where the learning is passive. However, direct instruction can include active cognitive engagement. Effective direct methods can provide cognitively engaging explanations, demonstrations, discussion and practical work (Ramnarain and Schuster, 2014).

2.3.4.2 Inquiry instructional approach

The reform science teaching standards require teachers at all grade levels to make substantive changes in their teaching (NRC, 1996). Perhaps the most important change is in
teaching science content through inquiry, rather than directly. The National Science Education Standards (NSES), (NRC, 1996) promote inquiry instruction: “Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world” (p. 23). Next Generation Science Standards (NGSS, 2013) promote inquiry instruction and so the teaching and learning of science through inquiry instruction is a rising trend in the USA.

According to the NRC (2012, p. 42), inquiry instruction includes eight scientific and engineering practices:

1. Asking questions (for science) and defining problems (for engineering),
2. Developing and using models,
3. Planning and carrying out investigations,
4. Analyzing and interpreting data,
5. Using mathematics and computational thinking,
6. Constructing explanations (for science) and designing solutions (for engineering),
7. Engaging in argument from evidence,
8. Obtaining, evaluating, and communicating information.

Sometimes, however, there are misconceptions or misunderstandings as to what inquiry instruction in science education means. Abell (2010, p. 107) suggests that inquiry has two main meanings:

1) Inquiry is a teaching orientation toward a style of an instruction. My literature review focuses on this meaning as related to teachers’ pedagogical orientations.
2) Inquiry also is as a pedagogical approach where it means scientific inquiry.

As a pedagogical approach, inquiry instruction encourages students to learn by asking questions. As a pedagogical approach, inquiry then elicits student ideas and provides an opportunity to explore or investigate their thoughts. In this process, students are able to reformulate their questions and thoughts. Finally, students discuss about their findings and finish with formalizing the concept or concepts.

Inquiry-based teaching in science education has many variations (Alberts, 2008). As noted by the National Research Council (2000), inquiry instruction can vary from instruction that is guided by the teacher to very open student-centered discovery instruction. In the classroom, similar to science, inquiry consists of “making observations, posing questions, examining books and other sources of information, planning investigations, reviewing what is already known in light of evidence, using tools to gather, analyze and interpret data, proposing answers, explanations and predictions, and communicating the results” (National Research Council 1996, p. 23). Cobern et al. (2010) describe inquiry instruction as involving student investigations for the purpose of discovering and constructing new knowledge through empirical techniques. Teachers need to be equipped with inquiry instruction methods for students to understand inquiry. However, many teachers have limited opportunities to learn science through inquiry or to conduct scientific inquiries themselves. Science teachers should both understand inquiry skills and use inquiry appropriately in their classrooms. Therefore, according to the NRC (2000), one must ask:

- What do teachers need to know and be able to do to use inquiry effectively?
- What kinds of professional development can help prospective and practicing teachers both develop and use inquiry-based strategies?
Inquiry-based instruction is challenging to even the most experienced science teachers (Gallagher 1989), but beginning science teachers face additional constraints. Researchers have explored the barriers that teachers experience in implementing inquiry lessons. The majority of the existing literature focuses on experienced teachers (Keys and Bryan 2001); however, the implementation of inquiry-based instruction is different for beginning science teachers.

2.3.5 Comparison of direct instructional and inquiry instructional approaches

Ramnarain and Schuster (2014) studied instructional orientations with a theoretical structure based on Ausubel’s theory of meaningful learning. They placed pedagogical orientation, science teaching approaches, and scientific inquiry within the context of PCK. They too drew on Magnusson et al. (1999) and Grossman (1990). They recognized the increasing popularity of inquiry instruction for developing students’ understanding of science concepts and principles as well as of scientific inquiry and the nature of science. However, they also thought that both direct instruction and inquiry instruction were supported within their Ausubelian theoretical, conceptual framework. The goal of inquiry instruction, they noted, is the meaningful learning of science, that is, a good understanding of science, not just the memorization of scientific facts. Ausubel argues that more than one type of instructional approach can lead to meaningful learning.

Using a ‘science teaching orientation spectrum’ can thus help identify orientations (Cobern et al., 2014). In the spectrum, teaching practices cover a wide range from didactic exposition though to open inquiry learning. Cobern et al. (2014) constructed the spectrum as: didactic direct, active direct, guided inquiry and open discovery. The first two instructional
strategies refer to direct-instruction teaching and the second two instructional strategies refer to inquiry-based teaching. This spectrum, based on Ausubel, can be represented using a two-dimensional diagram representing nature of learning along the horizontal axis and type of instruction along the vertical axis (Figure 2.2). Learning ranges from Rote to Meaningful and instructional type from Reception to Discovery. Note that Ausubel's terms Reception and Discovery are best reflected today by direct and inquiry.

According to Ramnarain and Schuster (2014), Ausubel’s use of reception and discovery are today best translated as direct and inquiry. The two-dimensional diagram shows that both reception (direct) and discovery (inquiry) learning can promote cognitive engagement with the subject matter leading to meaningful learning (quadrants I and IV). Didactic presentation leading to passive listening and rote memorization is represented by quadrant II. Unstructured hands-on activities with little guidance or no coherent ‘minds-on’ thread is represented by quadrant III.
since learning would be fragmented and not meaningful. According to Cobern et al. (2014), both guided inquiry and open inquiry can fall within quadrant IV in so far as instruction is cognitively engaging. Similarly, in so far as instruction is cognitively engaging, both didactic direct and active direct can fall within quadrant I.

Cobern et al. (2014) and Ramnarain and Schuster (2014) promote inquiry, but based on Ausubel’s quadrants they argue that both quadrants I and IV represent meaningful learning, while both quadrants II and III represent rote learning. Too often these quadrant pairs are collapsed so that only inquiry instruction is thought to lead to meaningful learning while direct instruction always leads to rote learning. Rather, both inquiry and direct instruction can lead to meaningful learning just as both can lead to rote, passive learning.

Schroeder et al. (2007) conducted a meta-analysis of research on science instructional approaches drawing on research published between 1980 and 2004. They examined the effect of specific science teaching strategies on student achievement. In the research project, they categorized the studies under ten strategies (Schroeder et al., 2007, p. 1445-1446):

- **Questioning strategies:** Teachers vary timing, positioning, or cognitive levels of questions (e.g., increasing wait time, adding pauses at key student-response points, including more high-cognitive-level questions, stopping visual media at key points and asking questions, posing comprehension questions to students at the start of a lesson or assignment).

- **Focusing strategies:** Teachers alert students to the intent of the lesson or capture their attention (e.g., providing objectives or reinforcing objectives at the middle or closing of lesson, using advance organizers).
• **Manipulation strategies:** Teachers provide students with opportunities to work or practice with physical objects (e.g., developing skills using manipulative or apparatus, drawing or constructing something).

• **Enhanced materials strategies:** Teachers modify instructional materials (e.g., rewriting or annotating text materials, tape recording directions, simplifying laboratory apparatus).

• **Assessment strategies:** Teachers change the frequency, purpose, or cognitive levels of testing/evaluation (e.g., providing immediate or explanatory feedback, using diagnostic testing, formative testing, retesting, testing for mastery).

• **Inquiry strategies:** Teachers use student-centered instruction that is less step-by-step and teacher-directed than traditional instruction; students answer scientific research questions by analyzing data (e.g., using guided or facilitated inquiry activities, laboratory inquiries).

• **Enhanced context strategies:** Teachers relate learning to students’ previous experiences or knowledge, or engage students’ interest through relating learning to the students’/school’s environment or setting (e.g., using problem-based learning, taking field trips, using the schoolyard for lessons, encouraging reflection).

*Instructional technology strategies:* Teachers use technology to enhance instruction (e.g., using computers, etc., for simulations; modeling abstract concepts and collecting data; showing videos to emphasize a concept; using pictures, photographs, or diagrams).

• **Direct instruction strategies:** Teachers deliver information verbally or explicitly guide students through a sequence of tasks (e.g., learning by listening, designing experiments, using a microscope, making measurements).

• **Collaborative learning strategies:** Teachers arrange students in flexible groups to work on various tasks (e.g., conducting lab exercises, inquiry projects, discussions).
Schroeder et al. (2007) tabulated and sorted teaching strategies and determined the overall effect size of each (See Table 2.1).

Table 2.1

*Ranking of Teaching Strategies (Schroeder et al., 2007, p. 1452)*

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Effect Size</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Context Strategies</td>
<td>1.48</td>
<td>1</td>
</tr>
<tr>
<td>Collaborative Learning Strategies</td>
<td>0.96</td>
<td>2</td>
</tr>
<tr>
<td>Questioning Strategies</td>
<td>0.74</td>
<td>3</td>
</tr>
<tr>
<td>Inquiry Strategies</td>
<td>0.65</td>
<td>4</td>
</tr>
<tr>
<td>Manipulation Strategies</td>
<td>0.57</td>
<td>5</td>
</tr>
<tr>
<td>Assessment Strategies</td>
<td>0.51</td>
<td>6</td>
</tr>
<tr>
<td>Instructional Technology Strategies</td>
<td>0.48</td>
<td>7</td>
</tr>
<tr>
<td>Enhanced Material Strategies</td>
<td>0.29</td>
<td>8</td>
</tr>
</tbody>
</table>

*Focusing strategies* and direct *instruction strategies* were excluded in the analysis because there were no studies meeting the criteria. Therefore, the study is limited with student-centered approaches. The problem is that when looking at the actual research, it favors inquiry in that it fails to compare research outcomes of inquiry instruction with research outcomes of direct *active* instruction. Rather, they report studies that compare inquiry instruction with simple lecture. In other words, the comparison is between instruction involving active learning and instruction involving passive learning. This research confounds active learning with inquiry instruction, and fails to recognize that direct instruction can involve student activity. The research reviewed by Schroeder et al. (2007) does not fairly represent research across Ausubel’s quadrants. Rather, it is an analysis of inquiry for meaningful learning compared with direct
instruction for rote learning. Thus, it is not possible to conclude from their meta-analysis what particular teaching strategy is best and it is possible that inquiry approaches are not necessarily more effective than direct instruction, assuming both include student engagement.

2.3.6 Summary

It can be concluded that the science education community strongly supports inquiry instructional approaches for science classrooms. It is argued that inquiry instruction promotes a deep, comprehensive understanding of science. However, the literature also includes data that science concepts can be taught more efficiently through direct explanations (Cobern et al., 2010; Schuster et al., 2017). As per Ausubel (1961), both direct instruction and inquiry instruction can lead to meaningful learning. The challenge is for teachers to create a balance among teaching approaches so that student learning is maximized.

2.4 Domain #3: Contextual Factors Effecting of Middle School Science Teachers in Practice

My research interests also include the contextual factors that can influence middle school science teachers’ pedagogical choices. As noted above, contextual factors can be both external and internal. This section focuses on how external contextual factors (educational environment factors such as district, community, school, classroom, and student) are associated with science teachers’ pedagogical orientations towards science teaching and their instructional practices.
2.4.1 Common external contextual factors impact on science teachers’ pedagogical orientations

This section aims to clarify common external factors and their relationship with middle school science teachers’ pedagogical orientations. Regardless of what professionals say about the best instructional approaches, when science teachers are in the classroom there are going to be factors that influence their instruction. It is thus important to examine teacher practice aside from what teachers might claim they want to do, and aside from what researchers and educators say teachers should do. There are numerous extrinsic dynamics that effect teacher practice. Some of these external factors are more predominant than others in the literature. Common factors include: school district, policy, class size, curriculum, standards, and prior knowledge of students, class time, and learning difficulties (misconceptions, preconceptions) of students. This literature review gathers common external contextual factors under two specific categories: student-based external contextual factors and school climate-based external contextual factors.

2.4.1.1 Student-based external contextual factors

Students contribute to contextual factors that influence teaching, with respect to their prior knowledge and misconceptions. Many researchers show that students are very important component of contextual issues and teachers should consider their students while constructing their teaching orientations (Friedrichsen and Dana, 2005; Boesdorfer, 2015). The literature tends to first consider prior knowledge of students or the readiness of students. Learners begin to build their new knowledge through their existing knowledge (Sinatra & Pintrich, 2003). Similarly, Ausubel (1968) emphasized that what the learner already knows is the essential factor
influencing learning, and teachers should elicit student knowledge on a topic before teaching on it. Prior knowledge of the students provides an indication of the alternative conceptions they may hold, as well as the scientific conceptions they already possess.

For instance, Hewson and Hewson (1983) considered how the learning of new scientific conceptions can be affected by students’ previously held alternative conceptions. In their study, Hewson and Hewson (1983) taught students the scientific conceptions of mass, volume, and density to two groups of students using two different instructional strategies. Their experimental instructional strategy was designed to lead students away from their existing knowledge, which included alternative conceptions, toward more accepted scientific knowledge. Their control condition used a direct instructional strategy with the logical presentation of concepts. The findings showed that the experimental instructional strategy designed to lead students away from their existing knowledge resulted in a significantly better acquisition of scientific conceptions and elimination of alternative conceptions than did the direct instructional strategy. The difference between the two strategies resulted from the fact that the experimental strategy explicitly dealt with student alternative conceptions, whereas the direct strategy did not. This study provides evidence that considering prior knowledge of the students and their alternative conceptions in the design of conceptual change strategies promotes the acquisition of new conceptions as a consequence of the exchange and differentiation of the existing conceptions, and the integration of new conceptions with existing conceptions. The results of the study indicate that teacher-based instructional orientations without considering prior knowledge of the students could fail to link existing knowledge of the students with new knowledge while student-based instructional orientations considering prior knowledge of the students might be more effective.
Another external contextual factor is student misconceptions (Shulman, 1986b; Magnusson et al., 1999; Lee & Luft, 2008). For different grade levels, students bring preconceptions to the learning of frequently taught topics and lessons. These preconceptions can be misconceptions that the teacher needs to address. Various instructional practices will most likely be fruitful in reorganizing the understanding of students, because those students are not the same as the students who have not seen those same science concepts yet (Shulman, 1986b).

Park and Oliver (2008) found that teachers’ understanding of students’ misconceptions was one of the major factors influencing pedagogical orientations translated to instructional practice. They gave a specific example from their participants. In one of participant teacher’s metal labs, students were asked to test as many chemical and physical properties of various metals as possible.

The students boiled, bent, hit, and applied other physical stresses. However, when students hit zinc with hammers, it shattered rather than bending as was expected. In that situation, Lucy was surprised by the outcome and reasoned that the zinc was oxidized and its characteristics significantly changed as a result. She realized that this incident might cause students to develop misconceptions about characteristics of metals. Thus, she decided to have students discuss the incident and then asked, “Why do you think the zinc shattered while the other metals bent when you hit them?” She then ended up leading a discussion about differences between compounds and elements though this was a topic which the students would learn in a later unit. (Park and Oliver 2008, p. 269)

Based on this statement, Park and Oliver (2008) implied that the teacher actively integrated her knowledge of subject matter, and students’ misconceptions related with metals (a specific science concept) at the unexpected moment, and then applied instructional strategies
such as questioning and discussion. This is a good example of how students’ misconceptions lead to a teacher’s decision about teaching a science concept in practice.

It is possible to extend these external contextual factors concerning students such as their physical and mental development (grade level is also a very important determiner for teachers), cultural issues, or motivation.

2.4.1.2 School climate-based external contextual factors

One of the most important factors associated with school climate is class size. Teachers and educators struggle providing a balance between teaching in theory and teaching in practice (Loughran, 1994). Teachers may lesson plan in their minds, but they are not able to implement as such in the classroom because of some issues. Therefore, class size is an important factor that teachers have to consider. Rice (1999) asserts that class size and the use of time impact instructional practices. According to her quantitative study, the amount of time devoted to instructional practice is related with types of instructional orientations; for example, working with small groups rather than using innovative instructional practices or leading whole-group discussion. Rice (1999) indicated that class size directly shapes the use of class time for instructional practice. Findings of the study demonstrated there is a negative correlation between class size and student performance. The study showed that small class size leads to the more effective teaching of science because instructional practices can be used more efficiently. Rice (1999) observed that smaller classes provide an environment in which teachers use less common, perhaps more innovative instructional methods. Smaller classes could be perceived as more manageable for this sort of student-centered, participative instructional strategy. Rice (1999) also
found other external contextual factors related to the classroom include the availability of teaching and learning materials and laboratory equipment and supplies.

Another school climate-based external contextual factor is curriculum. Teachers and educators must address what policymakers require from them. Instructional practices have to be applied in light of mandatory standards and learning objectives at different grade levels. These standards and learning objectives are like a guide book for teachers in the classroom. Unfortunately, curriculum can be an extreme influence on instructional practices of teachers. Policymakers require teachers to cover a curriculum that has many objectives for teaching and learning. Overloaded content is a challenge for teachers leading many teachers to prefer more teacher-based instructional practices.

Ramnarain and Schuster (2014) emphasized the important role of contextual factors on teachers’ pedagogical choices. The findings of their research showed a significant difference between the orientations of teachers at disadvantaged township schools and teachers at more privileged suburban schools. Ramnarain and Schuster (2014) found that teachers at township schools were more ‘active direct’ oriented. They tended to use direct exposition of science content followed by confirmatory practical work, while teachers at suburban schools were more inquiry oriented, tending to use guided inquiry with concepts being developed via a guided exploration. Friedrichsen and Dana (2005) investigated the impact of contextual factors on science teaching practice. They attempted to elucidate why teachers exhibit specific science teaching practices with respect to contextual factors. Their study pursues a substantive-level theory of science teaching orientations, which identifies contextual factors that influence the development of science teaching orientations. Friedrichsen and Dana (2005) preferred this form of representation to illustrate the complex interrelationships between the nature and probable
sources of science teaching orientations, as well as the means associated with supporting students’ attainment of these goals. Friedrichsen and Dana (2005) consider three types of instructional goals (affective domain goals, general schooling goals, and subject matter goals) for explaining the nature of the teachers’ science teaching orientations. They stated that "current classroom context," defined as "the particular classroom context in which the participants (teachers) taught" (p. 233), was one factor influencing the teachers’ instructional goals for teaching a particular grade level.

The most important finding of their research is that teaching practices are influenced by the context. Friedrichsen and Dana (2005) concluded that while science teaching orientations are shaped by knowledge and beliefs about teaching science, importantly, teaching practice is also shaped by teaching context. Their research suggests that it is important for science teachers to identify their own understanding and beliefs about science teaching and learning, and their beliefs about learners in the development of effective science PCK. However, the researchers importantly note that teaching practices are strongly influenced by classroom context (such as, time constraints), and also by prior work experiences and professional development. Data collection through classroom observations and interviews provides a better understanding of the teacher’s teaching and their school context; and Friedrichsen and Dana (2005) found that some contextual factors did influence teaching practices of the teachers. In addition, Friedrichsen and Dana (2005) recognized that there could be multiple teaching practices by teachers depending on contextual factors such as grade level, class time, class size, so on. While this is an interesting implication from the study, but still contextual factors include complex meaning that should be detailed or categorized for clarification. Based on these observations, Friedrichsen and Dana
showed the complex nature of teachers’ knowledge and beliefs about teaching science and external factors shaping practice.

Åhman et al. (2015) explored professional development as related with PCK and considered the influence of external factors on in-service science teachers’ teaching in practice. They asked, “What characterizes the teachers’ approaches to teaching?” for the purpose of identifying factors affecting participants’ teaching. Åhman et al. (2015) focused on external factors; however, the research question would imply that they should also have included internal factors in their study. It is not possible to ignore the factors inherent in teachers, such as teacher-efficacy, epistemological beliefs, and so on. Åhman et al. (2015) showed that teaching experience fundamentally shapes pedagogical orientations and thus teachers’ use of instructional approaches. Because of this, teaching experience should be considered when trying to understand teachers’ teaching orientations. For instance, Åhman et al. (2015) found that a teacher with four years of experience had a distinctly different pedagogical orientation than one with 22 years of experience.

For examining teacher’s professional development, Åhman et al. (2015) used the Content Representations (CoRe) instrument. CoRe illuminates participants’ planning, organizing, and reflection of a specific topic through “big ideas.” They evaluated the findings from two different perspectives (pragmatic approach and reflective approach) that emerged in teachers’ discussions. In the pragmatic approach, teachers discuss doing an activity but there is no explicit reflection or reasoning. In this discussion the students’ learning takes place implicitly. However, in the reflective approach teachers have explicit reflections relevant to teaching content and student learning. Teachers’ approaches shifted from pragmatic to reflective during the investigation process. In the pragmatic approach, the teachers recognized that external factors, such as the
curriculum and syllabus, text books, and the national tests had an influence on their teaching. Moreover, local factors such as class size, classroom, new classes, and time also affected their teaching.

According to the results, teachers indicated time, especially time limitations, as an important factor regarding instructional approaches. They also discussed the lack of practical exercises for the students and referred to the instructional material and how the textbook affects the way the teacher is teaching in practice. Organized discussions showed that teachers used external factors to justify the choices they made in their teaching.

2.4.2. Summary

Many researchers indicated that contextual factors have a significant impact on classroom teaching practices. According to the results, the research identified contextual factors such as class size, availability of resources, teacher competence and confidence, time constraints, student ability, school culture and parents’ expectations as influencing the methods adopted by teachers. Especially, this part of the results provided more information about the relationship between instructional strategy preferences of in-service teachers and effect of contextual factors. But, these various factors are complex and messy (Friedrichsen and Dana, 2005; Boesdorfer, 2015). Therefore, when investigating pedagogical orientations of science teachers in practice, researchers should use descriptors, such as those used in this review.

This section of the literature review has shown that both external and internal contextual factors play an important role with respect to shaping teaching practice (Friedrichsen and Dana, 2005; Nargund-Joshi, 2012; Ramnarain et al., 2016). Fundamental external factors such as
student characteristics, school environment, and curriculum are very important. Therefore, understanding teachers’ classroom practice requires taking into account external factors and internal factors. First of all, teachers need to successfully observe and understand the nature of their students’ and their requirements. Though, this is not enough. They then need to contend with the school climate, class size, teaching and learning materials, and district policies. Last, all these internal and external factors should be handled together for an explanation of how they shape pedagogical orientations of teachers in practice.

2.5 Synthesis of the Literature

This study reviewed the literature relevant to teaching orientations of science teachers, characteristics of science instructional approaches, and the influence of contextual factors on teaching science in practice. This study evaluated and discussed three domains of literature for support in understanding the pedagogical orientations of science teachers. My specific interests in this literature review are the three overarching domains of pedagogical orientations, science instructional approaches, and contextual factors. The review of studies related to middle school teachers’ pedagogical orientations in science education indicates significant influence on their instructional approaches. Analysis of the research has shown that different middle school science teachers adopt different teaching practices for teaching the same science content. Because of this, it is an important to understand the reasons why these teachers make different choices in their practice.

The literature review revealed some potential discussion topics with respect to middle school science teachers’ pedagogical orientations. For instance, there is concern in the literature
about how best to identify types and characteristics of middle school science teachers’ approaches to teaching in practice. There is a need for better understanding the coherence between middle school science teachers’ teaching preferences and pedagogical orientations. Another similar issue is clarifying the relationship between middle school science teachers’ teaching in theory and practice. All these are provocative issues and point out the gap in the current science education literature.

2.6 Purpose of the Study

Science teaching orientations can involve many different things, but the interest of this study is teacher orientations toward content instructional strategies and reasons for instructional strategy preferences. It is very important to clarify what extent middle school science teachers are oriented towards inquiry instructional practices. The development of inquiry practices will possibly challenge teachers given their own limited opportunities to learn science through inquiry. My research addresses the problem of limited knowledge about Turkish middle school science teachers’ readiness for inquiry science instruction practices. The study also focuses on teaching orientations with respect to teaching content. The purpose of the study is to gain a broad understanding of middle school Turkish science teachers’ pedagogical orientations by considering their instructional preferences, especially towards inquiry-based teaching.
2.7 Research Questions

Based on this literature and in parallel to the research goals there are four overarching research questions in the study:

1. What is the range of the pedagogical preferences among Turkish middle school science teachers with respect to POSTT-TR?
2. What do teachers’ pedagogical orientations appear to be and what reasons do they give for their pedagogical preferences?
3. What contextual factors impact the teachers’ implementation of classroom instructional practices?
4. How do teachers explain their actual classroom instructional practices?
3.1 Research Design

The four research questions were answered using a sequential explanatory mixed-methods design involving both quantitative and qualitative research approaches (Creswell, 2014). Mixed-methods designs have been used to merge quantitative and qualitative data into a single database to reinforce the quantitative and qualitative results from each (Creswell & Clark, 2007). A sequential exploratory mixed-method design was used in my study in that I began the research with a quantitative method and followed with a qualitative method involving detailed exploration of individuals for the purpose of exploring teachers’ pedagogical orientations. The important issue is deciding on the priority or weight of the quantitative and qualitative data collection and data analysis (Ivankova et al., 2006). In this study, the weight of the methodology is more on the qualitative phase. The strength of this mixed-methods design is providing an opportunity for the exploration of the quantitative results in more detail. This design is also helpful when facing unexpected results arising from the quantitative part of the study (Morse, 1991). On the other hand, the weakness of a sequential exploratory mixed methods design is that it can take a long time and strain the feasibility of resources for collecting and analyzing both types of data (Ivankova et al., 2006).

There are two reasons for using a quantitative research design in my study. First, the quantitative design provided a national, profile background of Turkish middle school science
teachers’ pedagogical orientations. Second, the quantitative design provided profiles that helped to inform the follow-up, qualitative interviews. The qualitative interview design added detail to the teaching orientation profile for each workshop teacher.

In this study, unit of analysis is not especially important because the study does not involve critical statistical comparisons. However, it may be helpful to highlight the levels of data analysis. The study involves three levels of analysis, or units of analysis, depending on the research question. The first research question focuses on understanding the national range of the pedagogical preferences among Turkish middle school science teachers with respect to the POSTT-TR. Hence, the level of analysis is the national teacher sample. The second, third, and fourth research questions are addressed through the qualitative data gathered from a smaller sample of teachers who were attending a workshop. The second study question first compares the POSTT-TR profile for the workshop teacher sample with the larger, national sample of teachers. In this case, the unit of analysis is the composite of teachers at the workshop and national levels. The data to address the rest of the second, the third, and the fourth research questions was gathered from individual teachers, and used individually rather than in any aggregated form. Thus, the level of analysis for these research questions is the individual teacher.

3.2 Instrumentation and Data Sources

In this research, two data sources were used: the POSTT-TR instrument and semi-structured interviews.
3.2.1 The POSTT-TR survey instrument

Cobern et al. (2014) reported on the development and validation of a science teaching assessment instrument called the Pedagogy of Science Teaching Test (POSTT). The aim of POSTT items is to illuminate the teaching orientations of pre- or in-service teachers based on a range of common pedagogical approaches. Thus, the POSTT addresses a fundamental assessment area where there are few instruments and should be of value in science teacher preparation programs (Cobern et al., 2011).

Each POSTT item presents a classroom vignette describing a specific science topic in a realistic K-8 science teaching context. Each vignette is followed by possible responses ranging from direct instruction through guided inquiry to discovery learning, called the Science Teaching Orientation Spectrum (see Table 1.1). The first two instructional strategies are forms of direct instruction and second two are forms of inquiry instructional strategies. The items have a multiple-choice format with four responses representing the four teaching strategies. The responses from several POSTT items are compiled as a profile that is indicative of the person’s science teaching pedagogical orientation.

I preferred using the POSTT instrument first because it provides a scale from direct to inquiry instructional approaches in parallel to NRC (1996) and NGSS (2013) standards. Second, the instrument includes many items regarding different science concepts in order to determine instructional practices or pedagogical orientations of in-service science teachers from kindergarten to 8th grade bands. Last, the POSTT items have potential for transadaptation to different languages and cultures (e.g., Asrin, 2014).

---

3 For more details concerning validity of the instrument see (Schuster et al., 2007).
3.2.1.1 Validation of the instrument

The POSTT items use vignettes that range from kindergarten to 8th grade with content across the disciplines of science. For a study with Turkish middle school teachers, I chose 10 items written with middle school vignettes and with content consistent with Turkish curricula. After consulting with colleagues and looking at other POSTT studies, 10 items seemed to be appropriate for the purposes of this study. 5 items were transadapted and 5 items were used from Güvenç and Sert (2013) translation for use in Turkey, dubbed the POSTT-TR. The POSTT-TR was validated by a group of Turkish, middle school science teachers and professors and revised as needed. By transadapted, I mean that the items were translated from English into Turkish using Turkish idioms and common expressions. Although the POSTT has items at all middle school grades, the POSTT-TR does not have any items at the 7th grade. None of the POSTT 7th grade items had content matching the Turkish 7th grade curriculum. This was not considered a problem since rarely would a Turkish middle school teacher be assigned to only one grade level.

3.2.2 Interviews

The interviews were conducted using a semi-structured protocol based on POSTT-TR item responses. An interview began by showing the interviewee his or her POSTT-TR responses; then the interviewees were asked about several items selected from the survey. The interview carried on probing additional questions concerning research questions. Specific interview protocol was followed for each interview section. The interview protocol questions were discussed until consensus was reached by the research committee members.
3.3 Participants and Sampling

This study collected data from two sets of Turkish middle school science teachers. First, contacting 600 teachers yielded a national sample of 533 middle school science teachers who returned completed surveys. Anonymous surveys were returned from the national sample coming from fifteen cities across seven different regions of Turkey (see Table 3.1 and Figure 3.1). In addition, twenty-three Turkish middle school science teachers who attended a middle school science teacher workshop at Muğla Sıtkı Koçman University filled out the POSTT-TR survey. Of these, 21 agreed to sit for a follow-up interview. The workshop sample data necessarily required names until all the data was collected. The survey data had to be matched with the interview data transcripts. Therefore, all reports used pseudonyms to protect the teachers’ identities. Demographic information of the workshop sample is provided in Table 3.2 below.
Table 3.1

*Returned Survey Distribution from the Cities with the Regions*

<table>
<thead>
<tr>
<th>City</th>
<th>Region</th>
<th># of returned survey (n=533)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankara</td>
<td>Central Anatolia Region</td>
<td>51</td>
</tr>
<tr>
<td>Çorum</td>
<td>Central Anatolia Region</td>
<td>65</td>
</tr>
<tr>
<td>Konya</td>
<td>Central Anatolia Region</td>
<td>22</td>
</tr>
<tr>
<td>Sivas</td>
<td>Central Anatolia Region</td>
<td>62</td>
</tr>
<tr>
<td>Sinop</td>
<td>Black Sea Region (Northern)</td>
<td>11</td>
</tr>
<tr>
<td>Trabzon</td>
<td>Black Sea Region (Northern)</td>
<td>44</td>
</tr>
<tr>
<td>Zonguldak</td>
<td>Black Sea Region (Northern)</td>
<td>66</td>
</tr>
<tr>
<td>Antalya</td>
<td>Mediterranean Region (Southern)</td>
<td>15</td>
</tr>
<tr>
<td>Hatay</td>
<td>Mediterranean Region (Southern)</td>
<td>9</td>
</tr>
<tr>
<td>İzmir</td>
<td>Aegean Region (Western)</td>
<td>22</td>
</tr>
<tr>
<td>Muğla</td>
<td>Aegean Region (Western)</td>
<td>7</td>
</tr>
<tr>
<td>Erzurum</td>
<td>Eastern Anatolia Region</td>
<td>45</td>
</tr>
<tr>
<td>Iğdır</td>
<td>Eastern Anatolia Region</td>
<td>40</td>
</tr>
<tr>
<td>Şanlıurfa</td>
<td>Southeastern Anatolia Region</td>
<td>37</td>
</tr>
<tr>
<td>İstanbul</td>
<td>Marmara Region (Northwestern)</td>
<td>37</td>
</tr>
</tbody>
</table>
Figure 3.1. The Survey Attendant Cities of Turkey Highlighted in Red Color

Table 3.2

Demographic Information of Workshop Sample

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Pseudonym</th>
<th>Gender</th>
<th>Field</th>
<th>Teaching Experience</th>
<th>Avg. Class Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metin</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Semih</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>Zerrin</td>
<td>Female</td>
<td>Science</td>
<td>3-5</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Ayten</td>
<td>Female</td>
<td>Science</td>
<td>5+</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Sibel</td>
<td>Female</td>
<td>Science</td>
<td>5+</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>NOT INTERVIEWED</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Müge</td>
<td>Female</td>
<td>Other</td>
<td>5+</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Yurdanur</td>
<td>Female</td>
<td>Science</td>
<td>5+</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Esin</td>
<td>Female</td>
<td>Chemistry</td>
<td>5+</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>Ferit</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>Hüseyin</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>29</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>NOT INTERVIEWED</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Pelin</td>
<td>Female</td>
<td>Physics</td>
<td>5+</td>
<td>35</td>
</tr>
<tr>
<td>14</td>
<td>Hale</td>
<td>Female</td>
<td>Science</td>
<td>5+</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>Hande</td>
<td>Female</td>
<td>Pure Chemistry</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>16</td>
<td>Ceren</td>
<td>Female</td>
<td>Science</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>17</td>
<td>Mahmut</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>18</td>
<td>Mert</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>35</td>
</tr>
<tr>
<td>19</td>
<td>Ünal</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>28</td>
</tr>
<tr>
<td>20</td>
<td>Zafer</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>21</td>
<td>Osman</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>25</td>
</tr>
<tr>
<td>22</td>
<td>Mete</td>
<td>Male</td>
<td>Biology</td>
<td>5+</td>
<td>30</td>
</tr>
<tr>
<td>23</td>
<td>Altan</td>
<td>Male</td>
<td>Science</td>
<td>5+</td>
<td>18</td>
</tr>
</tbody>
</table>
3.4 Data Collection Procedure

Quantitative data were collected from two teacher samples in Turkey: a large national sample and a smaller workshop sample. For the national sample, 600 teachers were contacted through the Provincial Directorates of their cities and asked to complete the POSTT-TR survey except for the teachers who constituted in the workshop list. They were to return the surveys by the same method. Subsequently, 533 anonymous, complete surveys were returned. The workshop sample was composed of 23 Turkish middle school science teachers attending a middle school science teacher workshop at Muğla Sıtkı Koçman University in Muğla, Turkey between September 5 and 9, 2016. The teachers learned and practiced inquiry-based teaching approaches for specific science concepts. The workshop (IV. Applied Science Workshop) was sponsored by the MoNE and the Turkish Academy of Sciences (TAS)\(^4\). The participating teachers were invited to participate in my study by the workshop instructors. All 23 workshop participants agreed to take the POSTT-TR survey. They took the survey on the opening morning of the workshop, (about 30 minutes). I attended the workshop and applied the survey and then scheduled follow-up interviews with the teachers.

Qualitative data was collected from 21 of 23 workshop group teachers who agreed to sit for interviews after they completed the POSTT-TR. The interviews were conducted in a private seminar room and were audiotaped. The interviews took up to 30 minutes to complete. The interviews were focused on three specific POSTT-TR items and used a semi-structured interview protocol aligned with the research questions (see Appendix F). The three items were chosen because they were the items that elicited a range of responses when the workshop group

\(^4\) For more information, visit official website of the Turkish Academy of Science (TAS) [http://www.tuba.gov.tr/mainpage/turkiye-bilimler-akademesi/mid/1/lang/eng/mid/227/](http://www.tuba.gov.tr/mainpage/turkiye-bilimler-akademesi/mid/1/lang/eng/mid/227/)
completed the quantitative aspect of the study. The interviews began with showing the interviewee his or her own responses to the three items. Referring to these items, the researcher asked probing questions in order to understand why a teacher would prefer one teaching strategy instead of the other strategies. The interviewee was also asked about factors impacting the use of various instructional approaches. Interviews were concluded by asking the interviewee for any additional comments on how he or she would teach science concepts. Then, the interview audio records were transcribed for analysis. The data collection procedure is summarized in Table 3.3 below.

Table 3.3

Summary of Data Collection Procedure

<table>
<thead>
<tr>
<th>Phase</th>
<th>Procedure</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quantitative Data Collection</td>
<td>POSTT-TR survey</td>
<td>Numerical data concerning teachers’ pedagogical preferences</td>
</tr>
<tr>
<td></td>
<td>National Sample (n=533)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Workshop Sample (n=23)</td>
<td></td>
</tr>
<tr>
<td>2. Quantitative Data Analysis</td>
<td>Frequencies</td>
<td>Descriptive statistics</td>
</tr>
<tr>
<td></td>
<td>Distributions</td>
<td></td>
</tr>
<tr>
<td>3. Connecting Quantitative and Qualitative Phases</td>
<td>Select subset of POSTT-TR items for structuring the individual semi-structured, face-to-face interviews with workshop sample</td>
<td>Subset of POSTT-TR items</td>
</tr>
<tr>
<td>4. QUALITATIVE Data Collection</td>
<td>Individual semi-structured, face-to-face interviews with workshop sample (n = 21) based on POSTT-TR data</td>
<td>Text data (Audio records, interview transcripts)</td>
</tr>
<tr>
<td>5. QUALITATIVE Data Analysis</td>
<td>Studying the interview transcripts in light of Research Questions 2, 3, 4.</td>
<td>Transcript summary for each teacher organized by Research Questions 2, 3, &amp; 4.</td>
</tr>
</tbody>
</table>
Table 3.3 - continued

<table>
<thead>
<tr>
<th>Research Questions 2, 3, 4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Validation of summaries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Integration of the Quantitative and Qualitative Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Review of numerical data, transcripts and summaries for teacher orientations in light of the Science Teaching Orientation Spectrum</td>
</tr>
<tr>
<td>• Review of numerical data, transcripts and summaries in light of Research Questions 2, 3, 4.</td>
</tr>
<tr>
<td>• Interpretation and explanation of the quantitative and qualitative results</td>
</tr>
<tr>
<td>• Validation of the above</td>
</tr>
</tbody>
</table>

✓ Teachers categorized
✓ Responses to Research Questions 2, 3, 4 with supporting quotes.
✓ Implications of findings
✓ Future research

Note: Adapted from “Visual Model for Mixed-Methods Sequential Explanatory Design Procedures” by Ivankova et al., 2006, p.16.

3.5 Data Analysis

The first research question involved the quantitative analysis of POSTT-TR data gathered from the national sample of Turkish in-service, middle school science teachers. The second, third and fourth research questions involved both quantitative and qualitative data analysis from a smaller group of Turkish in-service, middle school science teachers who were attending a science teaching workshop.
3.5.1. Quantitative data analysis

To address the first research question (what is the range of the pedagogical preferences among Turkish middle school science teachers with respect to POSTT-TR?), the POSTT-TR item responses from the 533 teachers were compiled as a composite profile of instructional preferences. The survey results analyzed through POSTT-TR survey answer key to determine pedagogical preference profiles of the national sample. The answer key was generated by considering the definition of each instructional approach based on the Science Teaching Orientation Spectrum (see Table 1.1.) and it is provided in the appendix (see Appendix D and E). Basic distribution and frequency statistical tests were applied for the quantitative analysis considering POSTT-TR item responses. With regard to the workshop participants, both individual POSTT-TR profiles and a composite POSTT-TR were created. The workshop composite profile was compared with the national sample profile as an indicator of similarity and dissimilarity with respect to pedagogical preference distributions.

3.5.2 Qualitative data analysis

Subsequent to the above comparison, the analysis proceeded to the 2nd, 3rd, and 4th research questions. The interview transcripts were subjected to standard qualitative techniques. The interview records were transcribed in Turkish and then translated to English. Since each interview was clearly based on the research questions, I decided to create a summary (organized by Research Questions 2, 3 and 4) for each interview. Creating summaries for each teacher maintained the integrity of each teacher and allowed me to capture a sense of each teacher’s
orientation toward teaching science. The summaries were independently validated by a research colleague. Based on the summaries, the interviewees were categorized by teaching orientation. Two researchers worked together arriving at a consensus on the categories and assignment to category.

A summary statement for Research Question Two (what are the reasons for teacher’s pedagogical preferences?) was arrived at by consensus with the statements based on the teaching orientation categories and supported by quotations from the transcripts.

Similarly, a summary statement for Research Question Three (what contextual factors impact teachers’ implementation of classroom pedagogical practices?) was arrived at by consensus and supported by quotations from the transcripts. This summary statement, however, was not based on the teaching orientation categories given that the influence of contextual factors crossed the category boundaries.

To address the fourth research question (how do teachers explain their actual classroom pedagogical practices?), the findings from the 2nd and 3rd research questions were compared and contrasted for the purpose of developing inferences about the relationship between pedagogical orientation and instructional orientation.

3.5.3 Generalizability

This study is not generalizable in terms of how generalization is typically understood statistically. However, the national sample of Turkish middle school science teachers is large (N=533) and the teachers come from fifteen cities in seven regions of Turkey. As such, the POSTT-TR profile from this sample is certainly indicative of Turkish middle school science
teachers. The workshop sample at 23 is quite small and it definitely is not representative of all Turkish middle school science teachers. These teachers were at the workshop because they were interested in improving their teaching and they chose a workshop that was specifically about inquiry instruction. Thus, they would not necessarily represent less concerned teachers nor teachers steadfastly committed to forms of direct instruction. They are teachers indicative of other teachers seeking to improve their practice.
CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter addresses four research questions and reports the results. The first research question involves the quantitative analysis of POSTT-TR data gathered from a large number of Turkish in-service middle school science teachers. The second, third and fourth research questions involve both quantitative and qualitative data analysis from a smaller sample of Turkish in-service middle school science teachers who were attending a science teaching workshop.

The quantitative analysis of data for the first research question is presented in the form of basic statistical distributions and frequencies to provide insight on Turkish middle school science teachers’ pedagogical preferences. The data was further broken out by item grade level given that the POSTT-TR items are at grades five, six and eight. The data was also broken out as direct and inquiry given that POSTT item response is composed of two direct-oriented instruction responses and two inquiry-oriented responses.

Combining the analysis of both quantitative and qualitative data from the workshop sample provides a more detailed teaching orientation profile for each workshop teacher. From this data the second research question regarding teacher reasoning for pedagogical practices is addressed. Similarly, the third and fourth research questions, which are about what contextual factors influence teachers’ instructional practices and what are their typical practices, are addressed.
4.2 Research Question One: What is the range of the pedagogical preferences among Turkish middle school science teachers with respect to POSTT-TR?

The first research question is addressed through the POSTT-TR data. The data was collected from 533 Turkish middle school science teachers. The data was first examined to determine how much variation there was across POSTT-TR item responses. This analysis is presented in Table 4.1. The findings indicate that all but one teacher (532 of 533) selected two or more pedagogical instruction types (DD, AD, GI, OI) at least once. Only one teacher chose the same pedagogy, guided inquiry, across all items. A clear majority of teachers (495 of 533) selected three or four possible pedagogical instructions at least once when responding POSTT-TR items. Another important point is more than half of the teachers (291 of 533) selected each pedagogical instruction at least one time. This result suggests that most teachers vary their pedagogical practices.

Table 4.1

Teacher Response Variation Across 533 Turkish Science Teachers

<table>
<thead>
<tr>
<th># of different pedagogical preferences</th>
<th># of teachers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 of 533 (0.2%)</td>
</tr>
<tr>
<td>2</td>
<td>37 of 533 (6.9%)</td>
</tr>
<tr>
<td>3</td>
<td>204 of 533 (38.3%)</td>
</tr>
<tr>
<td>4</td>
<td>291 of 533 (54.6%)</td>
</tr>
</tbody>
</table>

A further indication that teachers vary their instructional approaches is the item response distribution across four instructional practices, as shown in Figure 4.1. In that the POSTT-TR has
ten items, there are 10 opportunities to select each pedagogical approach. Thus, for 533 teachers, 5330 choices were made. Figure 4.1 shows that more than one teacher selected each of the four approaches. The most popular pedagogical choice was guided inquiry. Approximately 38% of the choices were for guided inquiry. Guided inquiry was followed in popularity by open inquiry, with approximately 25% of the choices. Following closely with approximately 24% of the choices was active direct. The least popular choice was didactic direct with approximately 14% of the choices. The distribution of pedagogies shows that guided inquiry was selected nearly three times more than didactic direct (13.65%).

![Figure 4.1. Item Response Distributions of Four Instructional Approaches across 533 Turkish Science Teachers](image-url)

*Figure 4.1. Item Response Distributions of Four Instructional Approaches across 533 Turkish Science Teachers*
The split between direct instruction and inquiry instruction orientations is further illuminated by aggregating the two direct instruction options that the two inquiry instruction options. See Table 4.2.

Table 4.2

*Aggregated Direct and Inquiry Instruction Responses Across 533 Turkish Science Teachers*

<table>
<thead>
<tr>
<th>Type of Instructional Approach</th>
<th>Direct</th>
<th>Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td># of response (n=533)</td>
<td>1989</td>
<td>3341</td>
</tr>
<tr>
<td>(%)</td>
<td>(37.32%)</td>
<td>(62.68%)</td>
</tr>
</tbody>
</table>

The Turkish middle school science teachers responding to the POSTT-TR favored one of the inquiry instruction options more than one of the direct instruction options. Approximately 63% of the choices were made for an inquiry option with approximately 37% of the choices made for a direct instruction option. Indeed, as shown in Table 4.3, only one out of 533 teachers chose only direct instruction options while 30 chose only one of the inquiry options. However, most teachers chose direct and inquiry responses at least one time. Of the 533 teachers responding, 502 (94.2%) chose a direct response option for at least one item and an inquiry response option for at least one item. The findings indicate a preference for inquiry options but not to the exclusion of direct instruction.
I was also interested to know if the grade level in the item scenarios was a factor in response choice. Table 4.4 shows the percentage of aggregated direct and aggregated inquiry response choices across three grade levels (each POSTT-TR item scenario has a grade level of 5, 6, or 8). The percentages favor the inquiry options across all three grade levels. However, while the split between direct instruction options and inquiry instruction options is similar for grades 6 and 8, and clearly favoring inquiry, the split on the 5th grade items is less pronounced.

Table 4.4

*Instructional Approach Choices With Respect To Grade Levels Across 533 Turkish Science Teachers*

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Direct (~ %)</th>
<th>Inquiry (~ %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th grade</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>6th grade</td>
<td>37%</td>
<td>63%</td>
</tr>
<tr>
<td>8th grade</td>
<td>34%</td>
<td>66%</td>
</tr>
</tbody>
</table>
4.2.1 Discussion: Research Question One

Research Question One asks, what is the range of the pedagogical preferences among Turkish middle school science teachers with respect to POSTT-TR? To address this question, 533 Turkish middle school science teachers responded to the 10 items of the POSTT-TR. The data presentation in Table 4.1 and Figure 4.1 clearly shows that the Turkish teachers were not wedded to a single instructional approach whether one of the inquiry approaches are one of the direct instruction approaches. Across the 10 items of the POSTT-TR, all four instructional options were chosen by the responding teachers. Indeed, Table 4.3 shows that the vast majority of the responding teachers chose both direct and inquiry options across the 10 items of the POSTT-TR. There was, however, a trend toward inquiry instructional approaches. The data shown for each of the response choices in Table 4.2 and the data aggregated as direct or inquiry in Table 4.3, trends toward inquiry.

These findings are similar to findings in other studies. The Turkish teachers’ responses to the 10 items of the POSTT-TR returned a pattern similar to the primary POSTT instrument on which the POSTT-TR is based (Cobern, et al., 2014) and 10 items that were transadapted for use in Indonesia (Asrin, 2014). Respondents to the POSTT, the POSTT-TR, and the POSTT-Indonesia spread their choices across the spectrum from didactic direct to open discovery.

What was unexpected about the Turkish teachers’ responses was how that data broke out by item-scenario, grade level. As will be discussed in the next sections, one might have thought that the eighth grade scenarios would draw more direct instruction responses because of a Turkish standardized test that given at the end of eighth grade. The data as displayed in Table 4.4
indicate something different. Surprisingly the items with fifth grade scenarios drew a larger percentage of direct instruction responses then did the items with eighth grade scenarios.

The data from the 533 Turkish middle school science teachers provides insight on the pedagogical orientations of Turkish science teachers. In light of Turkish policy, the trend towards inquiry instruction is promising. What this data does not provide, however, are the reasons that teachers have for their preferences, and more importantly, the data does not tell us to what extent the teachers put these preferences into practice or what contextual factors influence putting their preferences into practice. The next sections on research questions two, three, and four address these concerns.

4.3 Research Question Two: What do teachers’ pedagogical orientations appear to be and what reasons do they give for their pedagogical preferences?

As noted about, what the data from the 533 Turkish middle school science teachers does not provide are the reasons that teachers have for their pedagogical. The second research question addresses this point with data coming from 21 teacher interviews. These teachers were attending a workshop on science teaching. However, before discussing the data pertaining to Research Question Two, it is important to consider to what extent the workshop teachers are similar to the 533 teachers. For this purpose, I compared the pedagogical preference distributions from the two samples.
4.3.1 Quantitative analyses

Table 4.5 shows the POSTT-TR item response variation for the workshop sample and the national sample. The workshop had 23 participants but two of these declined to be interviewed.

Table 4.5

*Teacher Response Variation Across Workshop Sample and National Sample*

<table>
<thead>
<tr>
<th># of different pedagogical preferences</th>
<th># of Teachers (%) (Workshop, N=23)</th>
<th># of Teachers (%) (National, N=533)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 (0%)</td>
<td>1 (0.2%)</td>
</tr>
<tr>
<td>2</td>
<td>5 (21.7%)</td>
<td>37 (6.9%)</td>
</tr>
<tr>
<td>3</td>
<td>13 (56.6%)</td>
<td>204 (38.3%)</td>
</tr>
<tr>
<td>4</td>
<td>5 (21.7%)</td>
<td>291 (54.6%)</td>
</tr>
</tbody>
</table>

The findings indicate that the teachers in both samples tended to spread their response choices. No teacher in the workshop sample chose the same response for all items, and only one teacher in the 533 national sample choose the same pedagogy response for all items. The workshop teachers selected two or more pedagogical instruction types (DD, AD, GI, OI) at least once, with the majority of teachers (18 of 23) selecting three or four possible pedagogical instructions at least once when responding POSTT-TR items. The percentages for national sample are similar though a lower percentage of the national sample chose only two pedagogical responses. Table 4.6 shows the item response distribution across four instructional practices for both samples.
Table 4.6

Item Response Distribution Across Four Instructional Approaches (Workshop vs. National)

<table>
<thead>
<tr>
<th>Type of choice</th>
<th>DD</th>
<th>AD</th>
<th>GI</th>
<th>OI</th>
</tr>
</thead>
<tbody>
<tr>
<td># of response (n=230)</td>
<td>8 of 230</td>
<td>44 of 230</td>
<td>109 of 230</td>
<td>69 of 230</td>
</tr>
<tr>
<td>(%) [Workshop]</td>
<td>(3.5%)</td>
<td>(19.10%)</td>
<td>(47.4%)</td>
<td>(30.00%)</td>
</tr>
<tr>
<td># of response (n=5330)</td>
<td>728 of 5330</td>
<td>1261 of 5330</td>
<td>2019 of 5330</td>
<td>1322 of 5330</td>
</tr>
<tr>
<td>(%) [National]</td>
<td>(13.65%)</td>
<td>(23.65%)</td>
<td>(37.88%)</td>
<td>(24.80%)</td>
</tr>
</tbody>
</table>

There are 10 opportunities to select each pedagogical approach given that the POSTT-TR has ten items. Thus, the 23 teachers in the workshop sample made 230 choices and the 533 teachers of the national sample made 5330 choices. The findings indicated that in both samples each of the four choices was made at least once. At ~47%, the most popular pedagogical choice for the workshop sample was guided inquiry followed by open inquiry at about ~30%. The direct instruction responses were chose noticeably fewer times with active direct at ~19% and didactic direct at only ~4%. The distribution of pedagogies shows that guided inquiry (~47%) was selected nearly two times more than the aggregated direct instruction options (DD & AD – ~23%).

While the trend for the workshop teachers is toward inquiry instruction, the trend for the national sample is flatter (see Figure 4.2 below). For example, open inquiry and active direct were chosen about the same number of times. And while the balance between the direct instruction options aggregated and the inquiry instruction options aggregated is toward inquiry, the trend toward inquiry is not nearly as pronounced as it is for the workshop teachers.
As shown in Table 4.7, however, Turkish middle school science teachers in both samples favored some form of inquiry instruction over forms of direct instruction. Nevertheless, workshop sample teachers were more likely than the teachers in the national sample to choose an inquiry instruction response over a direct instruction response (see Figure 4.3 & 4.4).

*Figure 4.2. Histogram of Item Response Distribution Across Four Instructional Approaches (Workshop vs. National)*

- Workshop
- National

<table>
<thead>
<tr>
<th>Instructional Strategy</th>
<th>Workshop</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Didactic</td>
<td>3.50 %</td>
<td>13.65 %</td>
</tr>
<tr>
<td>Active Direct</td>
<td>19.10 %</td>
<td>23.65 %</td>
</tr>
<tr>
<td>Guided Inquiry</td>
<td>47.40 %</td>
<td>37.88 %</td>
</tr>
<tr>
<td>Open Inquiry</td>
<td>30.00 %</td>
<td>24.80 %</td>
</tr>
</tbody>
</table>
Table 4.7

*Item Response Distribution Aspect of Direct and Inquiry Instruction for Two Samples*

<table>
<thead>
<tr>
<th></th>
<th>Direct Instruction (DD/DA)</th>
<th>Inquiry Instruction (GI/OD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop (N=23)</td>
<td>52 of 230</td>
<td>178 of 230</td>
</tr>
<tr>
<td>National (N=533)</td>
<td>1989 of 5330</td>
<td>3341 of 5330</td>
</tr>
</tbody>
</table>

*Figure 4.3. Workshop Sample Item Response Distributions (%)*
Figure 4.4. National Sample Item Response Distributions (%)

The visual comparison of the above tables and figures is informative; however, the data can also be statistically compared. The characteristics of the data require that a non-parametric statistic be used. Therefore, I statistically tested both sample item responses using a chi-square as shown in Table 4.8 below. A statistical difference is clear ($p<.05$), thus confirming my visual comparison of the data. That the workshop sample would be more inclined toward inquiry than the national sample is not unexpected. The workshop was about inquiry-based teaching and it stands to reason that such a workshop would interest more inquiry-inclined teachers.
Table 4.8

*Crosstabulation Statistical Analysis of Both Sample Item Responses for POSTT-TR Items*

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Inquiry</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Workshop</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>52</td>
<td>178</td>
<td>230</td>
</tr>
<tr>
<td>Expected count</td>
<td>84.4</td>
<td>145.6</td>
<td></td>
</tr>
<tr>
<td><strong>National</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>1989</td>
<td>3341</td>
<td>5330</td>
</tr>
<tr>
<td>Expected count</td>
<td>1956.6</td>
<td>3373.4</td>
<td></td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>2041</td>
<td>3519</td>
<td>5560</td>
</tr>
</tbody>
</table>

* Alpha (α) level of p<.05
Pearson Chi-Square = 20.530, DF = 1, P-Value = 0.000
Fisher’s exact test: P-Value = 0.0000035

The item instructional approach variation amongst the workshop sample showed was similar to that of the national sample though statistically not identical.

As can be seen in Table 4.9 below, no teacher in the workshop sample and only one teacher in the national sample chose only one of the direct instruction options for all POSTT-TR items; whereas the percentages choosing only one of the inquiry instruction options were 22% and 6%, respectively. On the other hand, ~78% and ~94 of the workshop and national samples, respectively, chose both direct and inquiry teaching options. The sample data suggests that teachers tend to prefer both inquiry-oriented and direct-oriented instruction approaches in different situations although overall inquiry is slightly favored, especially in the workshop sample.
Table 4.9

*Teacher and Instructional Practice Variation Across Workshop and National Samples*

<table>
<thead>
<tr>
<th>Type of instructional practice selected</th>
<th># of teachers (%) Workshop (N=23)</th>
<th># of teachers (%) National (N=533)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated Direct Instruction options</td>
<td>0 of 23 (0.0%)</td>
<td>1 of 533 (0.2%)</td>
</tr>
<tr>
<td>Aggregated Inquiry Instruction options</td>
<td>5 of 23 (21.7%)</td>
<td>30 of 533 (5.6%)</td>
</tr>
<tr>
<td>Direct and Inquiry instruction options</td>
<td>18 of 23 (78.3%)</td>
<td>502 of 533 (94.2%)</td>
</tr>
</tbody>
</table>

Table 4.10 shows the percentage of aggregated direct and aggregated inquiry response choices broken out by the three grade levels found in the POSTT-TR items (each POSTT-TR item scenario has a grade level of 5, 6, or 8). This data was broken out when it became clear from the interviews that some teachers change their instructional choices when teaching 8th grade due to the 8th grade standardized test. Because of things said during the interviews, I became interested to know if item grade level was a factor in choice of instructional approach options.

Table 4.10

*Instructional Approach Choices With Respect to Grade Levels Across Workshop and National Samples*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Workshop</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct (~ %)</td>
<td>Inquiry (~ %)</td>
</tr>
<tr>
<td>5th grade</td>
<td>26%</td>
<td>74%</td>
</tr>
<tr>
<td>6th grade</td>
<td>26%</td>
<td>74%</td>
</tr>
<tr>
<td>8th grade</td>
<td>17%</td>
<td>83%</td>
</tr>
</tbody>
</table>

The percentages favor the inquiry options across all three grade levels for both samples. The percentages, however, are contrary to my interview-based suspicions. The choices for
inquiry go up with grade level rather than down. We know that responses on an instrument like the POSTT will not necessarily reflect teachers’ actual practices. The data summary in Table 4.10 may be indicative of that disjunction.

4.3.2 Qualitative analyses

Based on the interview summaries for each workshop participant interviewed (21 of 23), I identified and validated four general orientations that encompassed the 21 teachers interviewed. These were: direct-instruction oriented teachers (5 of 21), inquiry-instruction oriented teachers (9 of 21), mixed-instruction oriented teachers (9 of 21), and confused oriented teachers (2 of 21). Except for the last category, each category had two or more subcategories (see Table 4.11). While these categories do not align exactly with the Science Teaching Orientation Spectrum, they are descriptive of both how a teacher responded to the POSTT-TR items and what the teacher said about his or her own classroom instructional practice.

4.3.2.1. Direct Oriented Teachers

Based on their comments about teaching approaches, these teachers appeared to be more oriented towards direct instruction, but not all of them in the same way. Some in this group seemed more committed to direct instruction than the others. Some seemed to value student activities more than the others. Thus, the category was subdivided into quite direct-instruction oriented teachers and active direct-instruction oriented teachers. Each subgroup is described below.
4.3.2.2 Quite Direct Oriented Teachers

Only Metin fell into this subcategory. Interestingly, Metin’s POSTT-TR histogram (1AD, 7GI, 2OI) suggested he might be an inquiry oriented teacher, but he wasn’t. For example, when asked about what he is comfortable using as a teaching method, he responded: “I feel more comfortable myself when I lecture” (line 147). On the whole, his interview comments suggested that Metin thinks that there is a critical role for direct instruction. He appears to be direct instruction oriented that would like to use inquiry instruction. For example, Metin noted that it was important for students to ask their own questions, and that “student should explain their thoughts and summarize the topic with their own words” (lines 100 – 101) regarding item 2. But, Metin also complains that his use of activities is limited by the lack of materials, equipment, and facilities. Metin’s comments suggest that he primarily uses direct instruction approaches augmented by simple activities when possible. Therefore, he is categorized as a quite direct oriented teacher.
Table 4.11

*Teaching Orientation (TO) Types of Workshop Sample Teachers*

<table>
<thead>
<tr>
<th>P#</th>
<th>Pseudonym</th>
<th>Types of TO</th>
<th>Subtypes of TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metin</td>
<td>Direct Oriented</td>
<td>Quite Direct</td>
</tr>
<tr>
<td>11</td>
<td>Hüseyin</td>
<td>Direct Oriented</td>
<td>Active Direct</td>
</tr>
<tr>
<td>13</td>
<td>Pelin</td>
<td>Direct Oriented</td>
<td>Active Direct</td>
</tr>
<tr>
<td>18</td>
<td>Mert</td>
<td>Direct Oriented</td>
<td>Active Direct</td>
</tr>
<tr>
<td>22</td>
<td>Mete</td>
<td>Direct Oriented</td>
<td>Active Direct</td>
</tr>
<tr>
<td>8</td>
<td>Yurdanur</td>
<td>Inquiry Oriented</td>
<td>More Consistently Inquiry</td>
</tr>
<tr>
<td>16</td>
<td>Ceren</td>
<td>Inquiry Oriented</td>
<td>More Consistently Inquiry</td>
</tr>
<tr>
<td>19</td>
<td>Ünal</td>
<td>Inquiry Oriented</td>
<td>More Consistently Inquiry</td>
</tr>
<tr>
<td>20</td>
<td>Zafer</td>
<td>Inquiry Oriented</td>
<td>More Consistently Inquiry</td>
</tr>
<tr>
<td>21</td>
<td>Osman</td>
<td>Inquiry Oriented</td>
<td>More Consistently Inquiry</td>
</tr>
<tr>
<td>4</td>
<td>Ayten</td>
<td>Inquiry Oriented</td>
<td>Inquiry but Direct too</td>
</tr>
<tr>
<td>5</td>
<td>Sibel</td>
<td>Inquiry Oriented</td>
<td>Inquiry but Direct too</td>
</tr>
<tr>
<td>10</td>
<td>Ferit</td>
<td>Inquiry Oriented</td>
<td>Inquiry but Direct too</td>
</tr>
<tr>
<td>23</td>
<td>Altan</td>
<td>Inquiry Oriented</td>
<td>Inquiry but Direct too</td>
</tr>
<tr>
<td>2</td>
<td>Semih</td>
<td>Mixed Oriented</td>
<td>Transitional</td>
</tr>
<tr>
<td>7</td>
<td>Müge</td>
<td>Mixed Oriented</td>
<td>Transitional</td>
</tr>
<tr>
<td>9</td>
<td>Esin</td>
<td>Mixed Oriented</td>
<td>Transitional</td>
</tr>
<tr>
<td>14</td>
<td>Hale</td>
<td>Mixed Oriented</td>
<td>Context Dominated</td>
</tr>
<tr>
<td>17</td>
<td>Mahmut</td>
<td>Mixed Oriented</td>
<td>Context Dominated</td>
</tr>
<tr>
<td>3</td>
<td>Zerrin</td>
<td>Confused Oriented</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Hande</td>
<td>Confused Oriented</td>
<td></td>
</tr>
</tbody>
</table>
4.3.2.3 Active Direct Oriented Teachers

The other direct-instruction oriented teachers (Hüseyin, Pelin, Mete and Mert) spoke of their teaching similar to the Active Direct category on the Science Teaching Orientation Spectrum: The teacher presents the science concept or principle directly and explains it, followed by a student activity designed to demonstrate the presented science concept.

Hüseyin is one of these teachers. He appears to be a direct-instruction oriented teacher, although there is inconsistency with his POSTT-TR histogram (2AD, 4GI, 4OI). When he explained his choice of inquiry options, he clearly described inquiry within a direct instruction environment. For example, in explaining his open inquiry choice for POSTT-TR item 2, he said that the teacher’s role would be to “identify and fix incomplete or misunderstood parts of the unit” (line 84). Regarding item 10, Hüseyin chose the guided inquiry response because he approved of how the teacher got the students “to use what they have learned to explain” (lines 42 – 43) the student’s observation. In this way, he explained, “the students repeat their knowledge and brainstorm about the question” (lines 43 – 44). Regarding item 9, he rejected the open inquiry approach disagreeing that “the students should decide how to set up plants and light” (lines 8 – 9) because “they could set up [the activity] wrongly … and could lose much time when doing the activity” (lines 9 – 10). When looking these examples, overall his view of inquiry seems to be more that of confirmatory lab activities or observations that the students do subsequent to his explaining of concepts. On the other hand, Hüseyin chose the active direct approach for item 9 explaining that “the teacher should explain the main concepts to [the students] regarding the topic” (lines 3 – 4) followed by an activity in which the students are involved.
Similarly, Pelin’s interview comments indicate that she is a teacher who is very much inclined toward active direct instruction, although her POSTT-TR histogram is more balanced (1DD, 3AD, 3GI, 3OI). She is a teacher who values the involvement of students with activities, but under her direction. Pelin emphasized the importance of student activities explaining that “students learn through experience” (lines 4 – 5). Regarding item 10, Pelin noted that students should come to class with some knowledge about the moon and that the teacher’s job is to help students “construct new knowledge” (line 45) related to their “existing knowledge” (line 45). She is, however, quite concerned that students learn the objectives for the lesson, which is why she emphasizes the need for the teacher to conduct a lesson wrap-up, otherwise “students could miss learning objectives because they do not know the unit well enough” (lines 95 – 96).

Mete also appears to be an active direct-instruction oriented teacher, which is not consistent with his histogram (1AD, 5GI, 4OI). He says that he likes “using discovery based learning instruction” such as using a “question and answer method” (lines 167 – 168). This explanation is consistent with his histogram; he thus appears to be a teacher who values activities that he calls student-centered or inquiry. However, what he really seems to mean by inquiry is that students are given a chance to share their ideas about an activity, the procedures for which he has fully explained for them. For example, he said that during an activity he would guide students through the steps of the scientific method. Mete further explained that he knows his students and that “they miss something or forget to do something in the activity when” he is not in control. He says that the teacher needs to “explain the activity so that the students do not face a problem about setting up and observing the activity,” which would lead to unsuccessful results (lines 5 – 11). His description combines student-centered [inquiry instruction] activities along
with direct instruction, and thus appears to be more like active direct instruction than any inquiry instruction. His understanding of inquiry instruction is problematic.

In contrast to Hüseyin, Pelin and Mete, Mert consistently rejected inquiry options citing lack of student readiness and crowded classrooms, which is consistent with his POSTT-TR histogram (2DD, 7AD, 1GI). For example, in response to POSTT-TR item 9, Mert chose the active direct option. He referred to this option as being similar to what is required in the Turkish system. The “teacher explains the concept and then students do the activity to confirm the relationship” (lines 4 – 5). He noted that “some students don’t have prior knowledge” (line 4) needed for a lesson. He said that “I really want students to infer something from an activity or experiment, but students have different readiness levels” (lines 40 – 42). Mert is also influenced by contextual factors such as time limitations and the need to prepare students for the standardized test, saying, “there are time limitations and our education system requires us to prepare students for multiple-choice tests” (lines 71 – 73). His instructional preferences were clearly oriented to direct instruction, and he could have been categorized as quite direct except that he also clearly valued and used student activities. Therefore, along with Hüseyin, Pelin and Mete, he is categorized as an active direct oriented teacher.

4.3.2.4 Inquiry Oriented Teachers

These teachers were oriented toward inquiry instructional approaches. As with the direct instruction oriented teachers, however, this group is not homogeneous. They are subcategorized as more consistently inquiry oriented teachers or Inquiry but direct too. Moreover, all of the
teachers in this category though tending toward inquiry actually have a problematic understanding of inquiry.

4.3.2.4.1 More Consistently Inquiry Oriented Teachers

Yurdanur, Ceren, Ünal, Zafer and Osman were categorized as more consistently inquiry oriented teachers. For example, Yurdanur’s interview comments suggest that she attempts to use an inquiry style of instruction, which is consistent with her POSTT-TR histogram (8GI, 2OI). Yurdanur says that her motto is “learning by doing” (line 3), and she strongly rejects using a direct instruction approach explaining that “there is no inquiry, no investigation” (line 37) with direct instruction. With direct instruction, she added that the “teacher does everything” (line 38). Regarding POSTT-TR item 2, Yurdanur chose guided inquiry “because it is student-based teaching and they think for themselves” (line 65) using this method. She says that students “should lead the activities and find the solution for their problems” (lines 67 – 68). While Yurdanur may experience some barriers to inquiry instruction, it does not appear that the barriers keep her from using inquiry instruction approaches. However, while Yurdanur seems to prefer inquiry style instruction, she does not offer reasons beyond the need for students to be involved in a lesson.

Ceren is another teacher whose comments suggest that she attempts to use an inquiry style of instruction, which is consistent with her POSTT-TR histogram (7GI, 3OI). She explained that she prefers that students actually do experiments rather than simulations of experiments. Regarding POSTT-TR item 2, she found the open inquiry approach more interesting for students, which is important “because students do not forget what they learn when they are interested.
Their learning goes on due to their curiosity” (lines 85 – 86). Regarding item 9, Ceren again preferred the open inquiry approach this time explaining that it “provides an opportunity to the students to think more about the activity” (lines 3 – 4). Moreover, regarding item 10, she noted that the inquiry options provide “more freedom to the students for explaining and discussing” (line 47) but also noted that teachers need to “give some explanations and guide [students]” (lines 48 – 49). Furthermore, Ceren says that teachers need to love their students and not to judge them and that students should be allowed to speak in class. She likes to ask her students, “what [they] learned?” (line 132). Unlike Yurdanur, Ceren seems to have a clearer sense of why inquiry is a good instructional approach beyond something that she merely prefers.

Similarly, Ünal appears to be an inquiry-oriented teacher, which is consistent with his histogram (1DA, 4GI, 5OI). He reasoned that inquiry types of instruction lead to more meaningful learning and that students are encouraged to think for themselves. He argues that students are more motivated when they are more involved with a lesson. Regarding POSTT-TR item 2, Ünal chose the open inquiry response because the teacher gets the students more involved: “the teacher asks what main things are that [the students] have learned in the unit. The teacher also considers the students’ own ideas of what is important or interesting” (lines 92 – 93). He said that this is similar to how he teaches, and that, “we aim for student-based learning and we should provide [students] with more freedom during the learning process” (lines 5 – 6). He further explained that students “look at the topic from different perspectives unlike [the teachers]” (lines 6 – 7). In addition, Ünal is also a teacher who recognizes the differences among students at different grade levels, and adjusts his instruction to the level of students.

Zafer also appears to be an inquiry-oriented teacher, which is quite consistent with his histogram (8 GI; 2 OI). His notion of inquiry is something like guided inquiry instruction.
Talking about POSTT-TR item 2, Zafer said that he wants students to come up with their own ideas “wrong or incomplete” (lines 119 – 120), and then he would ask questions to help them “find the correct answer” (line 120). At the end, he “would summarize the unit with their correct answers” (lines 120 – 121). He supports the active involvement of students in a lesson.

Regarding item 10, Zafer said that in response to a student question, the students should research an answer; then “after researching and discussing the question, the students [would be] able to answer the question easily” (lines 58 – 59). While he does feel that there are some constraints to his teaching (such as facilities and time limitations, and his students’ academic strengths), he seems nonetheless to consistently use inquiry instructional approaches. When he cannot, he uses games and simulations. Like Yurdanur, Zafer not offer reasons for preferring inquiry instruction beyond the need for students to be involved in a lesson.

Osman is the last teacher in this inquiry category. Osman still tries to use activity-based, inquiry instruction, which is consistent with his histogram (9 GI; 1 OI). He takes students outside to the school playground “because science is life” (line 122). He attempts to arouse his students’ curiosity and tries to provide more freedom for their learning. He says he feels “comfortable myself if I can provide more freedom for my students in the classroom. Also, I feel good when I increase their motivation and curiosity” (lines 141 – 142). Regarding item 9, Osman also said that, “when teaching, I want students to wonder about the topic. Thus, I am able to increase their motivation” (lines 3 – 4). Osman also encourages students to share their ideas. For example, regarding item 2, he noted that “I would like to know my students’ ideas. I should check what I expect from them and what they think. I also asked them why the ideas more important than another one. I want them to find the original learning objectives through their own ways” (lines 89 – 91). Osman believes that “students are able to understand themselves” (line 56). On the
other hand, and more than the other teachers in this category, Osman feels the influence of standardized tests on his instructional practices: “standardized tests affect my teaching. Students and parents require us to prepare students for the standardized test” (lines 116 – 117). Thus while inquiry oriented, he is influenced by the standardized test more than the others in this category; and like several of the others he seems not to have much reason behind his preference for inquiry.

**4.3.2.4.2 Inquiry and Direct Too Teachers**

Ayten, Sibel, and Ferit are ‘inquiry and direct too’ teachers. They seem to be oriented toward inquiry instruction and yet also make use of direct instruction approaches. For example, Ayten appears to be a teacher who balances both direct and inquiry styles instruction, which is consistent with her POSTT-TR histogram (3AD, 5GI, 2OI). She says that she likes to begin a “lesson with an experiment or visuals to arouse students’ interest. Then the teacher is able to provide meaningful learning students by explaining the process more fully” (lines 3 – 4). On the other hand, she rejects one open inquiry response because she believes “that the teacher should be a guide during the learning process” (line 12). She explained that she wants students to have “more freedom in the classroom. However, teacher guidance is necessary” (lines 13 – 14). She believes that without teacher guidance, the students may have misconceptions. For example, regarding item 2, Ayten explained that “the concept of Earth science… [has] intangible concepts for students. Therefore, I prefer explaining the concepts… at the beginning part of the lesson” (lines 84 – 86). On the other hand, Ayten did not like the didactic direct option, “because the students do not have any role during the learning process. They are passive. The teacher restates
the learning objectives and relates them with specific concepts himself” (lines 91 – 93). In response to item 9, Ayten chose the guided inquiry response explaining that “according to my teaching perspective, the teacher should begin the lesson with an experiment or visuals to arouse students’ interest. Then the teacher is able to provide meaningful learning students by explaining the process more fully” (lines 3 – 4). About the item 10 scenario, Ayten said she liked that the teacher asked the rest of the class about the one student’s question, because “the students are actively involved in the learning process and explain their ideas and observations” (lines 45 – 46). Ayten clearly summarized her mixed teaching orientation saying “the teacher should arouse students’ interest with the activity and then guide them by explaining the lesson more fully” (lines 18 – 19). She could have been categorized as active direct but on the whole her comments tended more toward inquiry.

Sibel also appears to be an inquiry–instruction oriented teacher, which is consistent with her histogram (3AD, 3GI, 4OI). Her idea of inquiry, however, appears to include significant elements of direct instruction. Even when she chose an open inquiry approach, her additional comments on how she would teach the lesson indicate that her ideas were close to direct instruction. Her view of open inquiry would seem to be something between active direct and guided inquiry approaches rather than true open inquiry. Indeed, she suggested something like this when summarizing her comments on item 2; she would use ideas from the open inquiry approach and then wrap up with the active direct approach. Regarding item 9, Sibel chose the active direct response “because the teacher begins an explanation of the concepts to arouse the students’ interest. Then, the students do an activity to confirm…” the explanation (lines 3 – 4). Thus, the students are better able to learn the concepts. Although she chose the active direct response, she said that she would actually prefer the guided inquiry response because she wants
“to give the control to the students and they observed the relationship between chlorophyll on the sun” (lines 10–12). However, she did not select this option saying, “unfortunately this method takes too much time and there is the standardized test…” to consider. She explained, “I would prefer this teaching option if we didn’t have a time limitation problem and standardized test anxiety” (lines 10–11). In contrast to item 9, Sibel chose the open inquiry response for item 10, saying that it was “very similar to [her] teaching style” (line 45). When a student in her class asks a question that causes the students to think, she says “I guide and encourage them to share their ideas or possible explanations. I don’t say anything about their answers being true or false” (lines 45–47). She goes on to say that she would have them to perform an experiment if time permitted. At the end, however, she gives “them the correct answer and concludes the lesson” (line 49). Although she said she would not choose the guided inquiry approach, her explanation of how she would teach this lesson sounded more like guided inquiry than open inquiry. In summary, Sibel appears to be a teacher inclined toward inquiry instruction but also much influenced by the standardized test. Hence, her instruction appears to be ‘inquiry and direct too’ depending on time limitations.

Ferit is another teacher whose POSTT-TR histogram (1AD, 5GI, 4OI) looks like that of an inquiry oriented teacher. However, his interview comments about his own teaching suggest that his view of inquiry falls somewhere between active direct instruction and guided inquiry. For example, regarding item 9, Ferit chose the guided inquiry response saying, “I would give my students more freedom. Thus, they are able to explore and look at the activity from different perspectives” (lines 3–4). Nevertheless, he also indicated that the teacher can “give a short explanation to the students” (lines 21–22). Moreover, he said that he would “begin the lesson by giving some examples of how photosynthesis plays an important role in human life” then he
would “continue with thinking questions” (lines 29 – 30). But, for item 2 Ferit said he did not like the direct instruction approaches because they are “teacher based” with the teacher restating “the learning objectives and [relating] them with specific concepts.” The teacher “leads the students and they just follow what the teacher presents” (lines 158 – 160). He summed up his teaching saying that he likes to arouse “students interest through thinking questions or interesting activities,” and that he prefers “guiding [students] with questions sense [that way] they learn required learning objectives regarding the unit.” He concluded saying “I feel comfortable when my students do an activity or perform an experiment and then I conclude it” (lines 207 – 208, emphasis added). Ferit thus clearly stresses that students need to do activities but that that there is a role for direct instruction. Other than mentioning the importance of getting students actively involved with the lesson, he does not provide reasons for his pedagogical choices.

Last, Altan appears to be a guided inquiry-oriented teacher that also uses some direct instruction, which is consistent with his histogram (2AD; 6GI; 2OI). Altan rejected a direct instructional approach because “may be [the students] have different ideas or explanations in their minds. We are not able to know what they are thinking.” He disapproves of instruction where “students are not actively involved in the learning process” (lines 82 – 83) and where they “just match and confirm the learning objectives and related concepts as the teacher taught them” (lines 87 – 88). Regarding item 9, Altan chose an inquiry option, elaborating that “when a student asked this kind of thinking question I ask the other students what they think,” (lines 42 – 43) and he encourages the students to “share their ideas and we discuss about them” (line 44). However, he notes that if student comments are “incomplete” (line 44) by the end of a lesson, he completes and concludes the lesson for the students. He clearly sees that a teacher has a role in wrapping up a lesson and making sure that students come to a correct understanding of the lesson
objectives. In regard to a lesson on photosynthesis, Altan said he would first “provide [the students] with prior knowledge concerning what photosynthesis is and what factors influence it” (lines 36 – 37). He would then have them “test the factors” (line 37) with plants at home. Later the students “bring the plants to the classroom and explain what happened and why” (line 38). Altan explains that if the students’ explanations are correct he “verbally reinforce their success” (line 39). However, if they give an “inadequate explanation” (line 39), he completes their explanation. Altan strongly favors student involvement in a lesson, but he also thinks that the teacher has an important role. He seems to be an inquiry instruction teacher who uses inquiry to encourage student involvement in the lesson and then direct instruction to ensure that they have come to a correct understanding of the learning objectives. He did not offer reasons for his instructional preferences other than those students learn better with the approaches he describes.

4.3.2.5 Mixed Oriented Teachers

These teachers exhibited a mixed instructional practices orientation in that at times they supported both direct and inquiry instruction approaches. Unlike the teachers in the Inquiry Oriented category, these teachers’ preferred direct and inquiry instruction approaches somewhat evenly, though not for the same reasons. The category is subdivided into transitional oriented teachers and context dominated oriented teachers.
4.3.2.5.1 Transitional Oriented Teachers

Transitional oriented teachers have one of two types of characteristics. Either the teachers are in transition from a direct-instruction orientation to an inquiry-instruction orientation, or they specifically choose between direct and inquiry instructional approaches depending on what they are teaching.

For example, Semih appears to be a teacher who in the past was very direct-instruction oriented, using direct instruction methods, but is now attempting to change his instructional efforts so that he is more inquiry-oriented. The latter is reflected in his histogram (5GI; 5OI). Semih emphasized that attending instructional workshops has changed his mind. Therefore, he is now less direct instruction, and tries to use more inquiry style experiments. Regarding item 2, Semih noted that “students should relate their learning outcomes and experiences with their daily lives. It is the best way for students to present their main ideas” (lines 92 – 93). He further explained that he prefers for students to find results: “students should play an active role in the experiment. Thus, they are able to gain experience” (line 121). Similarly, regarding item 9, he clearly prefers inquiry-type instruction: “students should observe. Then, the teacher should explain supportive information and summarize the topic” (lines 8 – 9). Nevertheless, contextual factors appear to weigh heavy on him: “I can’t teach similarly [referring to inquiry] because of student based and environmental factors” (lines 55 – 56). Due to the “low readiness level of the students and lack of prior knowledge about a topic” (lines 28), he says that he “can’t efficiently teach with [inquiry] activities during the class time” (line 29). He says that direct instruction is necessary because of barriers such as inadequate laboratories, lack of materials, underprepared students, and insufficient time “for covering the whole curriculum” (line 73). When asked about
his own teaching, and about what instructional approaches he is comfortable with, Semih describe something like a Socratic question and answer approach: “I verbally examine general knowledge of the students through question and answer teaching method. I try to lead them to find the purpose of the unit (lines 113 – 114) …” and relate “the topic with daily life” (lines 114 – 115). Semih says he wants students to be active but the instruction he describes is more direct instruction than inquiry instruction: “I usually teach the lesson through websites/videos and require [students] to take notes” (lines 58 – 59). It is also notable that Semih does not provide an explanation for why an inquiry approach would be better than direct instruction; though he does suggest that students might be more interested if they can connect science with their daily lives.

From her interview comments, Müge appears to be a direct instruction–oriented teacher. Her reasons are primarily about factors in her classroom such as time limitations and student lack of interest. Regarding POSTT-TR item 10, Müge chose the active direct option saying that “it is similar to [her] teaching in the classroom” (line 45). She indicated that she would first give the students a short explanation and then follow with an activity such as having students create a model or diagrams. Regarding item 9, she actually said that the direct instruction responses were “okay because of time limitations” (lines 6 – 7). Müge said that she would “clarify the purpose of the activity then the students would gain the knowledge” (lines 15 – 16). However, Müge also says that the current workshop has changed her perspective on instruction and that she intends to adopt a more inquiry orientation in the future. Because of what she is learning at the workshop, she may be a teacher in transition which would account for her more inquiry-oriented histogram (2AD, 4GI, OI4).

Esin, in contrast to both Semih and Müge, seemed to purposefully balance direct and inquiry instruction, but still in transition. Consistent with her histogram (1DD, 4AD, 2GI, 3OI),
Esin appears to be a teacher who combines both direct instruction and inquiry instructional approaches. At one point, Esin said she feels “inadequate” (line 135) and that she needs to find “different activities” (line 136). She says that she wishes to encourage student “curiosity” (line 135): “I would like to address all the sense organs of the students” (line 131) and to use more “inquiry-based teaching techniques” (line 135). However, Esin also makes it clear that she thinks that stating learning objectives for the students is very important; and she is aware that this is a behaviorist technique. Thus for example, though for item 2 she chose the guided inquiry response (because it seemed similar to what she does in her own classroom), she said she would tell her students what the learning objectives are and then she ask “thinking questions concerning the learning objectives” (lines 79 – 80). She also said that the active direct response for item 10 was similar to what she did in the classroom: “it is the same as what I do sometimes” (line 34). She elaborated that she did not like the scenario for this item saying that she prefers to explain the concept herself: “I prefer to explain myself” (line 44). Because she currently feels “inadequate” (line 135) and that she needs to find “different activities” (line 136), and that she would like “to use more “inquiry-based teaching techniques” (line 135), she is categorized as transitional. And, like Semih and Müge, Esin does not provide an explanation for why an inquiry approach would be better than direct instruction.

4.3.2.5.2. Context Dominated Oriented Teachers

Hale and Mahmut are the last two teachers in the Mixed Orientation category and the two subcategorized as Context Dependent. More than the others, Hale and Mahmut appear to choose between inquiry and direct instruction depending on contextual factors, especially one factor: the
“Transition from Primary to Secondary Education” (TPSE) examination given at the end of 8th grade.

During her interview, Hale chose both inquiry instruction and direct instruction options, consistent with her histogram (2DD, 3AD, 3GI, 2OI). She appears to be a teacher who looks at teaching pragmatically. Because of the standardized exam system, she uses more direct instruction methods with her 8th grade students. For 8th grade she believes that inquiry methods require too much time. On the other hand, with 6th graders, where there is no exam pressure, Hale uses more inquiry instructional approaches. For example, regarding item 9, Hale preferred a more direct instructional approach. She chose the active direct approach saying that this was similar to how she taught photosynthesis. Hale explained, “I define what factors play a role in photosynthesis… and then students perform the experiment” (lines 3–5). She notes that for the experiment the students follow the teacher’s directions. Hale was clear that time limitations were important to her: “I can’t give more time… to the learning process. I can’t spend more time for experiments. Therefore, I explained and defined specific concepts…” (lines 28–29). However, contrary to her response for item 9, Hale preferred the open inquiry approach for item 10. She says, “I really like to discuss about an issue with my students” (line 40). “I promote inquiry-based learning for my students” (line 42). Then, Hale specifically noted that the grade level for item 9 was 6th grade where “there is no worry about time concerning anxiety of standardized test. These students are keener than upper classes” (lines 43–45).

Mahmut is another teacher who finds himself constrained by external factors. He appears to be an inquiry-oriented teacher, but one who believes that there is an important place for direct or teacher-centered instruction. He said that he had “adopted a constructivist approach” and knew “the importance of doing activities in the classroom” (lines 137–138). He also seems to be aware
of why an inquiry or student-center approach could be important. He notes that with the inquiry approach students learn scientific processes, they are more interested, and they learn to respect each other’s ideas. He also indicates that because they are not passive, their learning is more meaningful. Clearly, he is a teacher who would like to have his students be more involved with laboratory activities. However, like Hale, he feels constrained by the standardized test. With respect to 8th grade, he even said that he does “not use any innovative approach, technique with eighth-graders.” Instead he limits activities “and rarely performs experiments.” Instead, he has the students “practice… solving test questions” (lines 122–123). He feels that he cannot spend too much time on activities; therefore, he further explained that the teacher should provide the directions for an activity “because the student is generally too unfamiliar to set up an experiment” (lines 3–5). The students could than “observe and conclude their findings” (lines 5–6). On the other hand, regarding item 10, Mahmut chose the open inquiry option because the lower grade level allows him more time. In response to the student’s question in this item, he would want his “students to come up with their ideas and possible explanations and report these to the class” (lines 49–50). Mahmut also liked the guided inquiry option for item 10 because in that option the students also explained their observations (line 53); but he preferred the open inquiry option “because the students discuss about their observations.” His perspective shown in the interview is consistent with his histogram that is spread across all four instructional options (1DD, 3AD, 3GI, 3OI). His instructional approach is largely dictated by whether or not the students need to prepare for a standardized test. More so than many of the other teachers, Mahmut was able to offer reasons for preferring inquiry instruction over direct instruction.
Zerrin and Hande were categorized as Confused because while they made some comments in favor of inquiry, they seemed quite confused as to what inquiry actually is. It is unclear just how Zerrin is oriented. For example, in discussing item 10, she wanted to choose both open inquiry and didactic direct instruction. She explained that she “would require [the students] to come up with their ideas and possible explanations, followed by discussion. Then they would report these to the class” (lines 48 – 50). She went on to explain that she would subsequently use the direct didactic approach where she would explain the concept to the students. She said, “I don’t directly explain the concept. I like to have students think about the concept and the lesson” (lines 58 – 59). She elaborated saying, “first, the student should think about the question and share their ideas with classmates. Then the teacher should explain…” (lines 61 – 62) the concept. However, Zerrin never clarified how the student inquiry would be related to the concept she would eventually explain to the students. For item 9, Zerrin at first said that she preferred the open inquiry response, but moments later she said “wait a minute” (line 9) and that she changed her choice to the active direct response. While Zerrin said that she does not support using direct instruction, the instruction she described using has a significant teacher-centered component. What she described was sort of a student-centered, inquiry approach that she concludes by presenting an explanation of concepts unconnected with the students’ activity. In terms of the Science Teaching Orientation Spectrum, Zerrin described her teaching as something similar to active direct and guided inquiry but showing little understanding of what inquiry instruction really is. Hence she is categorized as Confused.
Hande displayed similar confusion about inquiry instruction. For example, regarding item 9, Hande chose the open inquiry response, “because the students decide how to set up plants and lights” (line 13). It would seem, however, that she finds some role for direct instruction because she preceded this comment saying, “I thought that the teacher must have [first] given information about this topic. Therefore, the students are able to draw conclusions themselves” (lines 3 – 5). In other words, her choice of the open inquiry option is dependent upon the teacher having completed some direct instruction. Indeed, she did not exactly reject the active direct response in that she said that “it is good” (line 7) but it was not the best option, in her opinion. Hande also thought that the guided inquiry option was good because it has the students doing an activity, but then the “teacher explains [the activity objective] fully” (line 11). She summarized her teaching saying that she prefers that “students do the activity themselves in the classroom and then the teacher should explain the lesson” (lines 17 – 18). As with Zerrin, Hande described using something like an inquiry approach but with her concluding the lesson by presenting an explanation of concepts seemingly unconnected with the students’ activity. As with Zerrin, she seemed to have little understanding of what inquiry instruction really is. Hence, she too is categorized as Confused.

4.3.3 Discussion: Research Question Two

Research Question Two seeks to clarify pedagogical orientations of Turkish middle school science teachers with their reasons. The question was addressed with a quantitative and qualitative analysis of the workshop sample data. As with the national sample, 23 Turkish middle school science teachers attending a workshop responded to the 10 items of the POSTT-TR.
Table 4.5 and 4.6 indicate that a majority of the workshop teachers (~78%) selected three or more instructional options at least one time across the 10 items of the POSTT-TR. The percentage is a little less than national sample teachers (~93%). The results show that workshop sample teachers tend to spread their response choices similar with national sample teachers.

Furthermore, as shown in Figure 4.2, the workshop sample and national sample again had similar patterns across the four instructional approaches. Although workshop sample was shifted more toward inquiry instruction than national sample, both samples still have a trend toward inquiry instructional approaches. The workshop sample preferred aggregated inquiry instruction option (GI/OI) approximately 14% more than national sample and this is statistically significant difference between these two samples. However, workshop sample generally reflects national sample.

The data of workshop sample indicates similar pattern with national sample with respect to grade level and instructional approaches. Table 4.10 represents both sample increase inquiry instruction preferences with the upper grade levels; however, workshop sample has a slighter change than national sample. Again, this result is surprisingly different from the national sample. It suggests that the teachers are not influenced by standardized test when deciding instructional practices in theory. Unfortunately, how they respond on the POSTT-TR may not be exactly the way would teach.

The interview data allowed me to categorize the teachers by instructional preferences: Direct Oriented, Inquiry Oriented, Mixed, and Confused. While these categories do not align exactly with the Science Teaching Orientation Spectrum, they are descriptive of both how a teacher responded to the POSTT-TR items and what the teacher said about his or her own classroom instructional practice. One of the reasons for interviewing the workshop teachers was
to determine the reasons teachers had for their pedagogical orientations. What I found was that most of the teachers had only superficial reasons for preferring forms of inquiry instruction (such as promoting student interest in a lesson). Moreover, many of the teachers appeared to have a faulty understanding of inquiry. Often times what they understood as inquiry was a teacher combining student activities with direct instruction. Two of the teachers seemed to be especially confused as to what inquiry instruction is really about. I took notice that one of these confused teachers had only a few years of teaching experience—much less than the other workshop teachers. Being a novice teacher might account for her confusion. The other confused teacher was not a novice but was a teacher who had not completed a teacher education program. Not having a formal science teacher education background could contribute to her confusion.

The good news is that the interview data supported the general preference for inquiry forms of instruction that was found in the quantitative data. It is also good news that some of the teachers appear to be consistent inquiry teachers. There are, however, reasons for concern: the lack of sophisticated rationales for instructional preferences, a problematic understanding of inquiry instruction, and the significant limiting effect of contextual factors. This last concern is addressed by Research Question Three.

4.4. Research Question Three: What contextual factors impact the teachers’ implementation of classroom instructional practices?

The third research question asks what contextual factors impact teachers’ implementation of classroom instructional practices. As with Research Question Two, this question was addressed using the interview data from the workshop, participating teachers. The interview
protocol specifically asked the teachers, “What factors influence your pedagogical choices?” However, during other parts of the interview teachers would occasionally mention factors affecting their pedagogical choices and instructional practices. Hence, I drew upon data from across each interview for arriving at a response to Research Question Three.

The teachers explained specific contextual factors during their interviews. From a qualitative analysis of the interview transcripts, six factors emerged, most of these cited by all the teachers. These are:

- The availability of materials and facilities for doing science activities,
- The need to prepare students for the 8th grade standardized test,
- Concerns about classroom management,
- Student related issues impacting instructional choices,
- Mandates from school administrators, and
- Turkish education policy and curriculum.

The subsections below address each of these factors providing details and examples from the transcripts.

4.4.1 **The availability of materials and facilities for doing science activities**

Of the 21 teachers interviewed, 18 indicated concerns about the lack of adequate materials and facilities at their schools for doing science activities. Inadequate materials and facilities for doing science activities were important contextual factors impacting teachers’ instructional practices. Many teachers said that their schools do not have separate science
laboratories and that classrooms have only basic facilities. Most classrooms seem to have chalkboards or SmartBoards, but not much specifically for science activities. For example,

- Metin noted “we do not have a science laboratory” (line 24). They “do not have a laboratory and adequate materials for doing experiments” (line 137).
- Zafer also noted that they “don’t have a science laboratory” (line 73) and that the lack of facilities hinders instruction. Moreover, Zafer commented that he has “difficulty finding materials for an activity or experiment” (line 26).
- Ferit indicated that the lack of materials can be a barrier to instruction. He noted that he does not have a microscope and that the school does not “provide necessary equipment or materials because of limited financial support” (lines 55 – 56).
- Ceren also mentioned not having precision scales, or dynamometer, or even litmus paper.

The teachers were also specific about how a lack of adequate materials and facilities affects instructional practice. For instance,

- Semih said that her school lacks of materials “for covering the whole curriculum” (line 73) and has inadequate laboratories, and that as a result direct instruction is necessary.
- Müge also indicated that the “lack of materials directly affects [her] teaching… [She is] not able to find main materials for an activity or experiment” (lines 25 – 26). As a result her students “are not able to benefit from observations or experiments” (lines 26 – 27).
- Similarly, Altan noted that his school is in a small city, and that his “students have difficulty finding necessary materials or equipment to perform any experiment. If five
things are necessary, we generally find three or four of them” (lines 104 – 106). If he is unable to find alternative materials, then they have to “skip the experiment” (lines 106 – 107) and rely on direct instruction.

- Esin noted that when she has trouble finding materials they “have to give up and cancel the activity” (lines 112 – 113).

- Pelin commented that when determining mass and volume, she “can’t use the laboratory effectively” (line 112) because of insufficient equipment.

- Mahmut noted that because of the “lack of materials in the laboratory” (line 29), he is “not able to benefit from the experiments in the laboratory” (lines 35–36).

- Hüseyin noted both that he lacks adequate materials and facilities, and that the school laboratory is actually far away from his classroom. These make it difficult to use the laboratory. He has to avoid “using the science laboratory because going and coming back from the laboratory loses extra time.”

For the most part, teachers indicated that it was their schools that lacked adequate materials and facilities. However, many teachers expect students to bring some materials from home, and sometimes teachers claim that the lack of materials results from undisciplined students. For example,

- Sibel said that students can be “irresponsible” in that they don’t bring materials to the classroom… some students do not bring the materials” (lines 113 – 115).

- Ayten also noted that sometimes students do not bring needed materials from home, and that this can be a barrier to instruction.

Ünal was another teacher who noted that sometimes students do not bring needed materials from home and that this can restrict what activities he uses in his classroom. However, he commented
that the lack of student discipline is not the only reason that sometimes students fail to bring
needed materials from home. Ünal noted that some students come from low income families that
cannot afford school materials. He then has to “find alternative materials” for activities and
experiments (lines 119 – 121).

When the teachers explained that inadequate materials and facilities for doing science
activities was an important contextual factors impacting their instructional practices, the
consequence was that teachers used low level inquiry instruction or direct instruction instead.

4.4.2 The need to prepare students for the 8th grade standardized test

Of the 21 teachers interviewed, 16 indicated that at 8th grade the Turkish standardized test
was a significant factor when making pedagogical choices. Students at 8th grade and their parents
often have test anxiety and they expect that the teacher will prepare the students for the test. For
example:

- Metin noted “there is standardized test anxiety for 8th graders” (line 27). As a
  consequence, they “practice test items instead of performing an experiment or doing
  an activity” (lines 37 – 38).

- Mahmut explained that for 8th graders, “both students and parents expect [the
  teachers] to prepare [the students] for the standardized test instead of doing more
  activities… Exam anxiety affects… teaching in the classroom” (lines 117–119).

- Esin also noted that exam anxiety “especially at the 8th grade” (line 108) is a factor in
  how she teaches, and that due to exams sometimes “students do not have enough time
to think and discuss about the topic” (line 86). “There is not enough time for doing activities” (line 108).

- Sibel explained that parents “require [her] to do fewer activities or experiments and practice more test questions” (lines 119 – 121). Because of the “high expectations of parents” for their children’s success on standardized tests, she has to do fewer activities with 8th graders and spend “additional time solving test questions” (lines 27 – 28).

- Osman said that, “students and parents require [teachers] to prepare students for the standardized test.” Thus the teachers “do less activity, observation or experiment and practice more for the exam” (lines 116 – 118).

As one can see in some of the comments above, standardized test anxiety can influence choices of instructional practice. Teachers change from what they might like to do in their classrooms to focus on test preparation. For example:

- Ünal might want to do “various activities or experiments” but he needs to be “completely sure” that is students are prepared for the standardized test (lines 121 – 123).

- Zafer explained that for his 8th graders he does activities quickly and uses direct instruction to actually give his students “more details and factors concerning” a topic, such as photosynthesis, that are not in the curriculum but could be on the test (lines 34 – 35).

- Osman noted “the eighth-grade curriculum includes many topics, but [teachers] have limited time to complete them because of standardized test preparation” (lines 27 – 28). Thus, he limits “activities, observations, or experiments” (line 34) that he might
want to do. “We do not have enough time for a long activity. Because of the standardized test, we generally spend less time than other grade levels to complete a unit” (lines 38 – 40).

- Müge further noted that time as a limitation: “I would like my students to perform an experiment or do an observation themselves and discuss about their ideas. Unfortunately, limited time in the classroom obligates me to lead my students and explain the important point about the unit” (lines 30 – 33).

- Mete was another teacher who said needing to focus on exam preparation limited time for other activities. He uses classroom time for his students to “practice for the standardized test by solving problems” (lines 34 – 35). He says that he has more time to do activities with 5th and 6th graders because there is no standardized test at those grades. However at 8th grade he said, “Unfortunately, I’m not able to follow a similar way for 8th graders. I generally use lecturing” and a question-and-answer teaching method (lines 51 – 53). He said that he would use open inquiry if it were not for the limitations of time (lines 82 – 83).

Even school administrators put pressure on teachers to prepare students for the 8th grade standardized test. For example, Mete said that school administrators do not always appreciate the activities that he would like to do. He said that his “school is very successful in standardized tests” and “therefore the school administrator and parents have high expectations from us” (lines 153 – 154).

Unfortunately, the Turkish 8th grade standardized test with its multiple-choice questions emphasizes the memorization of information assessed by. The test does not assess higher order thinking skills. These teachers are saying that because their students face this exam, they tend to
use more direct instruction so that they can more quickly cover material. They then spend considerable time having students practice test items. As a consequence, at the 8th grade these teachers use fewer science instructional activities and inquiry-oriented approaches.

4.4.3 Concerns about overcrowded classrooms and management

Of the 21 teachers interviewed, seven said that classroom management issues can impact their instructional decisions. Sometimes, the management issues arise due to class size and crowded conditions. For example,

- When he has a large class, Metin prefers “to lecture instead of [doing] an experiment… Otherwise, it is difficult to control or manage the classroom” (lines 136 – 138).

- Faced with an overcrowded classroom, Mert said, “I can’t teach with experiments because of a crowded class size. Therefore, I need to explain the concepts more” (lines 44 – 46). “I generally explain the concepts and ask questions” (line 91) because of overcrowding.

- Hande noted that “students are not able to perform the experiment themselves in a crowded classroom” (lines 106 – 107). She, therefore, has to “perform the experiment on behalf of [the students] and they observe” (line 107).

- Similarly, Ceren said, “I spend less time student in a crowded classroom. If I share more time with my students, we can communicate better and [student] success increases” (lines 111 – 113).
• Ferit indicated that sometimes he has difficulties with student discipline when classroom conditions are crowded. The crowded class conditions keep him from spending “enough time for each student” (lines 185 – 186).

• Hüseyin explained that he faced “classroom/laboratory [student] management problems” (lines 68 – 70) that make doing activities difficult.

• Zafer explained that classroom management can be a problem when they have to do experiments in the classroom rather than in science laboratory.

For these teachers, classroom management due to overcrowded conditions was a significant barrier to instruction. In order to cope with the crowded classrooms, the teachers tended to opt for direct instruction practices even if they would have preferred to use more inquiry-oriented instructional practices.

4.4.4 Student related issues impacting instructional choices

Of the 21 teachers interviewed, 14 mentioned three student issues that can impact their instructional choices. One of these is student lack of appropriate prior knowledge and readiness for the current lessons. For example,

• Metin noted that if students do not have relevant prior knowledge, “it is necessary to provide them with that prior knowledge when teaching the unit” (lines 31 – 32).

• Mahmut explained that he would like his “students to do the activity themselves and control all steps of the activity,” but his students “have inadequate readiness level and prior knowledge” (lines 37–39).
• Ünal commented, for example, that his “students don’t know chemical reactions or don’t like chemistry topics. Therefore, they have difficulty learning the formula for photosynthesis. They lose their motivation about the topic” (lines 26 – 28).

Moreover, teachers specifically noted that student lack of relevant prior knowledge level influences their instructional practices. For example,

• Semih explained that due to the “low readiness level of the students and lack of prior knowledge about a topic” (lines 28), he “can’t efficiently benefit from [inquiry] activities during the class time” (line 29).

• Hande also indicated that students “have inadequate prior knowledge from previous years” (line 30 -31). As a consequence, she says, “I perform the experiment myself and barely ask [the students] their thoughts (line 109 -110).

Other teachers specifically noted that student lack of physical and mental development (e.g., grade level, motor skills, and interest areas) influences their instructional practices. For example,

• Ünal commented on the importance of grade level when deciding specific pedagogical instruction. For example, for POSTT-TR Item 10, he reasoned that the open inquiry response was not appropriate because 6th graders “could not be able to record their ideas or possible explanations properly without teacher guidance. Then, they could have misconceptions” (lines 53 – 55). He said that 6th graders can have difficulties and that “they need help when explaining their ideas and relating them to their daily lives” (lines 106 – 107).

• Sibel also noted that at lower grades time can be a factor given that “activities take a long time because 5th and 6th grade students [have weaker] motor skills” (line 72).
Similarly, Zafer indicated that 6th graders may need more direct instruction because “it is difficult to follow a question-and-answer teaching method, especially for thinking questions, for this grade level” (lines 80 – 81).

Lack of student motivation was another inhibiting factor mentioned by teachers, and that there were various reasons for the lack of student motivation. For example,

• Sibel noted that some students have “economic problems because they are coming from low income families. Some of them have family related problems such as divorced parents” (lines 115 – 118), and thus, according to Sibel, the students are less motivated at school.

• Hüseyin commented that some “parents are less interested in their children’s education. Therefore, the students do not do their homework and come to class with low motivation and inappropriate prior knowledge” (lines 29 – 30). He further explained that, “even though I prefer my students share their ideas and discuss with their classmates, I sometimes need to lead them and give them more explanations or definitions” (lines 110 – 112).

• Hale said that some “students’ parents don’t care…” (line 95) and as a result “some students are less motivated” (line 95).

• Mahmut also indicated that parents are not always supportive. He said that he “would like… students to do group work” but “parents are prejudiced about the benefit of group study and they prefer students to study alone” (lines 114–117).

• Similarly, Hande observed that her “school is in an area that poor and uneducated people live in.” She said these “students are not interested… because their families don’t care about school” (lines 28 – 29). Thus, she said “I spend additional time
motivating my students. Therefore, I generally have limited time to complete a unit” (lines 107 – 109).

- Mete commented specifically that “parents are not interested in their children’s education” and that “parents don’t care what their children do about an experiment” (lines 41 – 44). As a consequence, students can be irresponsible and then he does “not do the experiment with them because they do not follow the directions correctly. Then, we are not able to find correct results” (lines 58 – 60).

- Zafer attributed some motivation problems to the school calendar. She said student motivation wans as summer approaches: “because of the spring, the students have low motivation and may be absent from school” (lines 136 – 137).

The teachers made it clear that these student factors did indeed influence their instructional decisions. For example,

- Müge noted that there are immigrant students “from different cities” that lack motivation; “many of them do not bring their books to the classroom” (lines 20 – 22). These students have an impact on her instructional decisions.

- Zafer noted that, “unfortunately, thinking and discussing about… intangible concepts with students doesn’t work if there are not enough successful students in the classroom” (lines 98 – 99). With less successful students, and when there is a “time limitation problem” (lines 99 – 100) he prefers to have “students do simulations in the computer laboratory” (line 100).

- Esin explained why she prefers direct instruction rather than inquiry instruction. Inquiry lessons require more class time and she noted that “students have different levels of interest” (line 22) towards a lesson and that less motivated students require
more direct instruction. She says, “I provide more explanations for lower-level
motivated students” (line 27).

Teachers noted other factors such as students’ experiences in lower grades and whether
students come from rural or urban communities. For example,

- Zafer explained that 6th graders can have difficulties coming to conclusions based on
  “their findings and observations” (line 84) because they “gain learning habits like
  writing or taking teachers notes from elementary or kindergarten teachers” (lines 82 –
  83). He also indicated that he would like to use group work but his “students are
  unfamiliar with group study because of their low readiness level coming from
  previous years” (lines 44 – 45).

- Metin noted a difference between students who come from urban and rural areas. He
  said that “students who come from urban areas learn better when they perform
  experiments” (line 131). However, he also said that rural area students are “more
  familiar with life science topics and can easily understand when I lecture” (lines 132
  – 133) about those topics. He said the situation reverses with the topic such as
  motion: “this time the students who come from an urban area can understand the topic
  easier because they have seen metros, tramways so many times” (lines 134 – 135).

Across the three student issues that teachers said impact their instructional choices, it was
clear that the impact was the less frequent use of inquiry-oriented instruction and the more
frequent use of direct-oriented instruction.
4.4.5 Mandates from school administrators

While the contextual factors discussed above were cited by many of the 21 interviewed teachers, there were two other factors that got only slight mention. Two of the teachers commented that mandates from their school administrators impacted their instructional decisions.

- Ünal noted that sometimes school administrators and other teachers are not happy if he does activities with his students because they “complain that we make noise in the classroom” (lines 127 – 128).
- Ayten she would “like to organize outdoor activities or science tours, but the school administrator doesn’t give permission because of a limited budget” (lines 106 – 107).

4.4.6 Turkish education policy and curriculum

And last, four teachers said that Turkish education policy and curriculum inhibited more inquiry-oriented instruction, which was strange to hear since the 2006 and 2013 Ministry of National Education (MoNE) revision specifically included constructivist teaching strategies that are typically thought of as more inquiry-oriented. Nevertheless,

- Osman said that he did not like the “existing education policy for science education” (line 125) because science teachers “should teach scientific thinking and scientific literacy instead of teaching” for simplistic learning (line 127). He apparently views the Turkish curriculum as emphasizing simplistic learning.
• Ferit said that the Turkish curriculum inhibits a constructivist approach to the teaching of science because in the curriculum “there is no helpful information… regarding how teachers can help students relate specific science concepts with their daily lives” (lines 47 – 49). He seems to be of the view that constructivist means making connections with daily life.

• And Metin noted that Turkish textbooks are a problem. He said that they “generally follow the activities from the textbook, but [the textbook] is frequently changed” (lines 139 – 140) -- “almost every year” (line 141).

It is understandable that teachers would have difficulties if the Turkish Ministry of National Education frequently changes textbooks that the teachers relay on. That only one teacher made this observation makes one wonder how accurate the observation is. And only one teacher commented that the Turkish curriculum emphasizes simplistic learning, and so again one wonders about the accuracy of this claim. The one teacher’s comment about constructivism and relating science to daily life seems to be a misunderstanding of constructivism. With respect to the vast majority of comments made by the other teachers interviewed these comments about Turkish education policy and curriculum are outliers. Hence, they will not be included in the rest of my discussion of the research.

4.4.7 Discussion: Research Question Three

Research Question Three addresses the contextual factors that influence teachers’ actual classroom instructional decisions. In light of the teacher self-reports, six contextual factors come to the forefront. These are materials/facilities, the 8th grade standardized test, classroom
management, student origin issues, school administrator issues, and Turkish education policy. General views of the teachers indicate that these factors incline teachers toward more direct instruction or lower level inquiry instruction in the classroom.

During the interviews, the teachers were asked what contextual factors impact their implementation of classroom instructional practices. In response, all of the teachers primarily interpreted contextual factors to mean factors that limited their instructional choices. Only two teachers spoke of positive contextual factors with respect to their instruction in addition to negative factors.

- Zerrin said that she worked in “good school” (line 39) where she has sufficient materials and that her “students are interested in science topics and they have high levels of readiness” (lines 40 – 41).
- Sibel seemed to have a positive view of her classroom. She noted that “class-size is a positive factor because there are [only] approximately 20 students” in her classes, and that she has access to a “science laboratory and adequate materials for experiments” (lines 108 – 110).

Nevertheless, most of the comments were that contextual factors limited a teacher’s instructional options. Semih seemed to speak for many of the teachers when he said that he does not use inquiry instruction as much as he would like to, and more direct instruction than he would like to. He said, “I try to use inquiry instruction. However, external factors have an effect” (line 71). “I can’t teach [using inquiry] because of student based and environmental factors” (lines 55 – 56).
4.5 Research Question Four: How do teachers explain their actual classroom instructional practices?

Another important role of this study is helping to identify the consistency between what teachers say are their instructional preferences and what they actually do in the classroom. Research Question Four focused on this issue. As with Research Question Two and Three, this question was addressed using the interview data from the workshop sample of teachers. The interview protocol specifically asked the teachers, “How do you typically teach the same science topics or similar topics in your classroom?” However, during other parts of the interview teachers would occasionally talk about their teaching when explaining their responses to POSTT-TR items. Therefore, I organized the results of Research Question Four around the categorization of teaching orientation types and subtypes from Research Question Two.

4.5.1 Direct oriented (quite direct oriented) teachers

When asked about his own teaching approach, Metin consistently indicated that direct instruction plays an important role in his actual classroom instructional practices. For instance,

- Metin responded “I lecture on the topic first and then give homework…” (line 44).

He also likes to have students write summaries that he then edits. He uses homework and he has students solve questions from the textbook, “then we solve the questions together in the classroom” (lines 115 – 116).

Metin also does some activities. For example,
He noted that “I have just experimented with the effect of water on photosynthesis (lines 41 – 42) … we tested plant growth by giving different amounts of water to similar plants” (lines 42 – 43).

Nevertheless, he appears to have an active direct teaching orientation. Furthermore, Metin mentioned contextual factors that influence his decision to use direct instruct. For instance, he noted that they did not have a science laboratory for laboratory work. On the other hand, Metin sometimes uses an inquiry instructional approach depending on the topic. For instance, he likes to use the 5E Instructional Model. As an example, he described his teaching of a unit on sound. He brings “thick and thin wire to the classroom” (lines 62 – 63). The students then “observe the sound of both wires and discuss the reasons why these wires make different sounds. We begin the class this way to arouse the curiosity of the students” (lines 63 – 64).

However, with his emphasis on lecturing, Metin appears to be direct instruction oriented teacher who uses some student activities.

4.5.2 Direct oriented (active direct oriented) teachers

When asked about their own teaching, four teachers described more active direct instruction approaches. They do not exactly describe active direct instruction but make comments that suggest they use something like an active direct approach. For example:

- Hüseyin said, “I provide the concept at the beginning of class. Then my students perform the experiment or the activity” (lines 34 -35). And, he believes he “should give [the students] directions on how to set up the activity” (line 19).
- Mert ends a lesson or unit by clarifying the concepts. He refers to his approach as “student–teacher–student” (line 104). He also uses homework and he likes to have students prepare poster presentations. He advises students to consult websites for more information.

- Mete said that he follows the “learning objectives from the textbook” and that he uses an open “question and answer teaching methods based on the examples from the textbook.” Then he tests the students “to evaluate how well they learned the objectives” and he corrects “their wrong answers through a question and answer teaching method” (lines 142 – 146).

- Mete likes to “guide [the students] following the steps of the scientific method” explaining that “they are not able to comprehend the steps, for example, hypothesis, procedure, experiment etc., very well” (lines 28 – 30).

The teachers specifically mentioned contextual factors that influence their instructional decisions to favor direct instruction activities. For example,

- Considering time constraints, Mert notes “unfortunately” (line 140) he has to use “teacher-based approaches” (line 140). “I first explain the concepts and then do an activity or perform an experiment. Otherwise, we need to spend too much time and time limitation is a very important issue in the classroom” (lines 38 – 40).

- Pelin attaches importance to grade level for her instructional decisions. The experiments Pelin speaks of are direct instruction for her fifth graders. She said, “I write the experiment topic and directions (step-by-step) on the whiteboard” (lines 139 – 140) “I need to explain each stage” (lines 140 – 141). However, she allows her 6th to “set up an experiment and perform it themselves” (line 141).
• Hüseyin said some “parents are less interested in their children education. Therefore, the students do not do their homework and come to class with low motivation or inappropriate prior knowledge” (lines 29 – 30). He further explained “even though I prefer my students share their ideas and discuss… with their classmates, I sometimes need to lead them and give them more explanations or definitions” (lines 110 – 112).

On the other hand, the teachers emphasized the importance of having students involved with activities, group work, and discussions. Even so, the teachers prefer to remain in control of the lessons. For example,

• Pelin says she prepares “a discussion platform before doing the experiment. I also perform the experiment. I wrap-up the experiment if we face any problems concerning results” (lines 142 – 143). She also described using group work for activities and providing opportunities for groups to share their findings. Students “present their findings in four-five minute presentations or they prepare PowerPoint presentations” (lines 77 – 78).

• Mete indicated that he would use group work and have students discuss their work. Then he would summarize their work (lines 85 – 90).

• Mert uses “thinking questions” (lines 146 – 147) and he gives “positive reinforcement to the students” (line 148) when they are able to make inferences. But, he then returns to “teacher-based teaching for the rest of the students” (lines 148-149).

While not exactly describing their teaching as active direct, the way in which these teachers appear to combine direct instruction with student activities suggests that active direct accurately describes their science teaching orientation.
4.5.3 Inquiry oriented (more consistently inquiry oriented) teachers

When asked about their own teaching, five teachers were more clearly oriented toward inquiry instruction. As with the active direct teachers, the inquiry teachers do not exactly describe inquiry when they speak of their own teaching but their comments suggest that they use something like a guided inquiry approach. For example:

- Yurdanur says that she likes to construct lessons where the students have more freedom. She provides the equipment and the experimental set up for students but then she has the students to the activities. She likes to use small group activities where the students conduct experiments. She guides a discussion once they have their results.

- Ceren uses group work for doing activities and then “students compare and interpret their experiment results” (line 40). She believes that it is important for the teacher to “evoke [student] prior knowledge or experiences” (line 18) and “if students face a problem or difficulty, the teacher should give them some clues” (lines 19 – 20).

- Zafer said, “I begin the class with a question or an activity…” (lines 32 – 33). He described having students “think about a question based on what they have learned and they would share with the class” (lines 64 – 65). He then “guide[s] them and [they] conclude together” (line 65).

- Osman said, “I want them to find original learning objectives through their own ways” (line 91). “I prefer that students make an inference about the unit themselves” (lines 94 – 95). He encourages student involvement: “after the students identify their important main ideas, I … require them to share their ideas with [the class]” (lines 104 – 105).
• Zafer says that he is “comfortable when using constructivist [he means inquiry] teaching methods and [having] students discover the knowledge by experiencing it themselves” (lines 147 – 148).

The teachers believe that with inquiry forms of instruction, students have fun and their curiosity is aroused, and they are motivated leading to more meaningful learning. Hence,

• Yurdanur said that she tried to make science fun and interesting.

• Ceren uses “thinking question[s]” (line 46). She likes to “ask [the students] a provocative question to arouse curiosity” (line 54).

• Ünal said that he “supports more activity-based teaching” and believes that “students should have fun in the school for [there to be] meaningful learning” (lines 136 – 137). Ünal says he tries to find “cheaper, alternative materials” so that he can do activities, and that he is “always [seeking] new activities and methods to arouse students’ interests” (lines 139 – 142).

• Osman wants “students to wonder about the topic. Thus, I am able to increase their motivation” (line 3 – 4). He said that he uses a “constructivist [inquiry] approach and asks questions to the students” (line 41) so that they “comprehend the topic themselves” (line 42).

However, under the influence of contextual factors, even some of the more inquiry-oriented teachers change their practices. For example,

• Zafer distinguishes between more and less successful students. With successful students, he uses “thinking question and group discussion methods” (lines 88 – 89), but with less successful students he uses “more visuals such as videos and simulations” (lines 89 – 90). Moreover, at the end of the lesson after student discussion, Zafer he “summarize[s] the
unit with [students’] correct answers” (lines 120 – 121). “I conclude a unit depending on the learning objectives and specific concepts from the curriculum using student ideas and thoughts” (lines 142 – 143).

- Osman believe that there is a role for direct instruction, especially at the eighth grade. For example, in commenting on an 8th grade lesson (item 9), he said, “after completing the activity, I would explain the topic” (line 20). He says that he tries to explain reasons. Regarding photosynthesis, for example, he says, “I define for them the photosynthesis cycle” (line 44). He then goes on to ask questions. “Why is it important? How does it happen?” (lines 43 – 44).

As with the previous section, what these teachers spoke about during their interviews was not exactly guided inquiry, let alone open inquiry. Nevertheless, they clearly described getting students involved with inquiry forms of activities under the teacher’s guidance. They are more consistent users of inquiry, thus distinguishing themselves from the other teachers who use more direct instruction.

4.5.4 Inquiry oriented (inquiry but direct too) teachers

The teachers who emphasized either direct or inquiry instruction were categorized rather easily as having more direct or more inquiry-instruction orientations. But, it was not always easy to categorize a teacher’s practice. Those teachers placed in the Inquiry but direct too category, are those that seemed less inquiry oriented because of the stress they put on direct instruction while still describing inquiry forms of instruction. These are teachers who to appear to use
guided inquiry instruction but with a significant direct active instruction component. For example,

- Altan said he uses either demonstrations or he has his students perform experiments. For example, Altan said that for a lesson like the one on photosynthesis he would first “provide [the students] with prior knowledge concerning what photosynthesis is and what factors influence it” (lines 36 – 37). He would then have them “test the factors” (line 37) with plants at home. Later the students “bring the plants to the classroom and explain what and why happened” (line 38). Altan explains that if the students’ explanations are correct he “verbally reinforce their success” (line 39). However, if they give an “inadequate explanation” (line 39), he completes their explanation. Sometimes he requires the students to take notes. For example, sometimes he gives them 15 minutes for “writing central ideas of the unit in their notebooks” (lines 116 – 117).

- Ferit described using a question and answer kind of approach: “I asked these questions to several students and get their answers. Then the students begin to think about the reasons and possible answer of these questions. I arouse curiosity…” (lines 75 – 77). They then do an experiment. Nevertheless, Ferit also said that he needed to use “more visuals and direct instruction” explaining that he sometimes “spends too much time organizing an activity or experiment” thus running into a time problem (lines 200 – 202). He summed up his teaching saying that he likes to arouse “students interest through thinking questions or interesting activities,” and that he prefers “guiding [students] with questions sense [that way] they learn required learning objectives regarding the unit.” He concluded saying, “I feel comfortable in my students do an activity or perform an experiment and then I conclude it” (lines 207 – 208, emphasis added).
Ferit’s last comment above is indicative of this category. He feels “comfortable” having his students do activities or experiments, but then he is clear that a lesson ends with him concluding it. The commitment to direct instruction in this category is more pronounced than for the More Consistently Inquiry Oriented teachers.

4.5.5 Mixed oriented (transitional oriented) teachers

One could conclude from their comments about how they teach that Müge, Semih, and Esin have a direct-instruction orientation.

- Müge: “I lecture verbally because group discussion or similar methods take too much time. Especially for teaching less interested and motivated students” (lines 76 – 77). “I prefer my students to read the unit from the textbook at the beginning of the class” (line 132).

- Semih: “I can’t teach similarly [referring to inquiry] because of student based and environmental factors” (lines 55 – 56). “I verbally examine general knowledge of the students through question and answer teaching method. I try to lead them to find the purpose of the unit” (lines 113 – 114). “Lecturing is too easy for me...” (line 119).

- Esin: “I also draw schema when I lecture about the phases of the moon” (line 42). “I explain a little bit and then require [the students] to explain or draw their schemas on the whiteboard” (lines 46 – 47).

However, each of these teachers also expressed an interest in adopting more inquiry forms of instruction. Müge and Semih seem to have been influenced by the workshop they were attending.
Müge said that the current workshop has “changed [her] perspective concerning [her] teaching] and that she will now “focus more on inquiry-based teaching” and “ask more why–questions to [her] students” (lines 149 – 150). She says that she now intends to “begin the class with thinking questions about the concepts or playing small games” (lines 149-151).

Semih said, “I desire students find something themselves. I just want to give some supportive information if it is necessary” (lines 83-84). “Before the workshops, I used to use lecture or question and answer teaching methods. Now, I try to provide equipment and require [students] to focus on the experiment. I plan to begin the unit with an activity and gett student more involved in the activity. Don’t give them the result and encourage using inquiry for finding their own results” (lines 131-134).

Esin also expressed an interest in changing her approach to teaching, but she did not indicate that the workshop had influenced her nor did her comments suggest that she would come soon.

Esin said that she feels “inadequate” (line 135) and that she needs to find “different activities” (line 136). She says that she wishes to encourage student “curiosity” (line 135). “I would like to address all sense organs of the students” (line 131) and to use more “inquiry-based teaching techniques” (line 135).

What these teachers have in common that distinguishes them from the other direct-instruction oriented teachers is that they are direct instruction teachers who appear to be dissatisfied and wish to change their teaching orientation. Thus they are categorized as *Transitional Oriented*. 
4.5.6 Mixed oriented (context dominated oriented) teachers

When asked about their own teaching preferences, Hale and Mahmut indicated that it depended on whether or not they were teaching eighth graders. Eighth graders face the Transition from Primary to Secondary Education (TPSE) exam and these teachers shifted their instructional methods to what they thought would best prepare the students for this exam.

- For 8th grade, Hale said, “I begin the class with my lecture. I emphasize and explain important points… related with the standardized test” (line 33 – 34). On the other hand for sixth grade, she likes to have student discussions where at the end of the lesson she provides the “correct explanation related with their prior knowledge” (line 56). She also likes to have students work in groups. She says, “we perform experiments” (line 113), and she uses a “question and answer teaching method” (line 114). She also believes that it is important to help students relate “knowledge with their daily life situations” (line 118).

- Similarly Mahmut said that he feels “comfortable… when doing activities or performing experiments with the students” and that he “really likes collecting data with the students and drawing inferences from their findings by discussion” (lines 130–131). Nevertheless, Mahmut said that he does “not use any innovative approach, technique with eighth-graders.” Instead they limit activities “and rarely perform experiments.” Instead, he has the students “practice… solving test questions” (lines 122–123)

These two teachers are Context Dominated and the context is the Transition from Primary to Secondary Education (TPSE) exam. Most of the teachers interviewed commented on standardized test pressures, but Hale and Mahmut were the most explicit about changing their instructional approach because of the TPSE.
4.5.7 Confused oriented teachers

Zerrin and Hande were the most difficult to categorize because they either contradicted themselves at various times or they seemed not to understand the terms they were using. It was especially difficult to know what to think about Zerrin’s approach to teaching. For example, in her discussion of item 10, she wanted to choose both open inquiry and didactic direct instruction. What she then described appears to be an open inquiry lesson that she concludes by presenting an explanation of concepts unconnected with the students’ activity: “first, the student should think about the question and share their ideas with classmates. Then the teacher should explain…” (lines 61 – 62) the concept. She says that she does not support using direct instruction and yet the instruction she describes using has a significant teacher-centered component: the “teacher has to lead [the students] to gain the required learning objectives” (line 92).

Hande appears to be a guided inquiry-oriented teacher; however, her view of inquiry involves considerable direct instruction. It seems to be her practice to end a lesson by providing explanations: “last I need to explain (sometimes I require them to take notes) the [the activity objective] and conclude myself because of their lack of motivation and interest and inadequate prior knowledge” (lines 77 – 79). After endorsing inquiry instruction, she says, “I perform the experiment myself and barely ask [the students] their thoughts” (line 109 – 110).

These are not teachers who appear to purposefully use both direct and inquiry instruction. They certainly do not seem to be in transition from a direct instruction orientation to an inquiry orientation. They are probably direct instruction teachers, but the way they describe their teaching, they certainly are Confused.
4.5.8 Discussion: Research Question Four

Regarding the fourth research question, the findings showed a consistency between teachers’ choices for the POSTT-TR items and what they said they did in their own classrooms. Hence, what the teachers reported as their actual practices fell fairly well into the teaching orientation categories developed for the second research question. If there is inconsistency with their actual classroom practices and responses regarding POSTT-TR items, the teachers generally pointed out contextual factors as a reason such as standardized test preparation.

Some of the teachers are more accurate inquire. However, some of them are scarily not accurate inquire. Self-report of the teachers give us limited information about how much they reflect their actual classroom practices. I have no reason they are accurate or not. Maybe in the future, they should be accurate inquiry, but they are not now.

Teacher reflection through self-report could be problematic because the teachers may reflect on what instruction they practice, but this maybe unrelated to their in class instructional practices.
CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

5.1 Conclusions

As mentioned in Chapter One, TCF (2006, 2013) goals and expectations require that Turkish middle school science teachers understand inquiry oriented instructional approaches and be ready to implement inquiry instruction. Given that the TCF documents are as recent as 2013, it is important to investigate Turkish middle school science teachers’ readiness for inquiry science instruction practices. Therefore, the research was conducted to clarify Turkish middle school science teachers’ pedagogical orientations by considering direct and inquiry instructional approaches in specific science content areas. I addressed the following research questions:

1. What is the range of the pedagogical preferences among Turkish middle school science teachers with respect to the POSTT-TR?
2. What do teachers’ pedagogical orientations appear to be and what reasons do they give for their pedagogical preferences?
3. What contextual factors impact the teachers’ implementation of classroom instructional practices?
4. How do teachers explain their actual classroom instructional practices?

For the first research question, a national sample of Turkish middle school science teachers (N= 533) was asked to respond to the POSTT-TR. The results of that survey found that
very few teachers (~7%) picked only one or two instructional approaches across all the items. This result shows that a majority of teachers (~93%) preferred to use various instructional approaches when they teach different science concepts (see Table 4.1). However, there preferences favored inquiry instructional approaches, especially guided inquiry instruction (see Figure 4.1). The aggregated direct and inquiry instruction responses across the national sample also indicates that inquiry is favored (see Table 4.2). Therefore, we can say there is a trend toward inquiry instructional preferences amongst middle school science teachers in Turkey. This is what Turkish policy makers require from middle school science teachers. Nevertheless, as one can see in Table 4.2, there is still substantial preference for direct instruction among the teachers. Indeed, almost all of the teachers (~94%) selected direct and inquiry instruction at least one time when answering the 10 items of POSTT-TR (see Table 4.3). Both direct and inquiry instruction formats were favored depending on the item. Moreover, even though inquiry approaches tended to be favored, interview data regarding the POSTT-TR items and instructional choice responses suggests that teachers do not always fully understand inquiry instruction.

In addressing the second research question, the results of quantitative data analysis showed that many of workshop sample teachers (~78%) preferred to select various instructional approaches across the 10 items of the POSTT-TR. The distributions for the workshop sample and the national sample were similar (see Table 4.5). For example, as with the national sample, a majority of the workshop sample teachers (~78%) also selected direct and inquiry instruction at least one time across all the items (see Table 4.9). The distribution for instructional approach choices with respect to grade levels across workshop and national samples was also similar. Unexpectedly teachers in both samples more frequently chose inquiry instruction options for upper grades than lower grades (see Table 4.10). On the other hand, the preference for inquiry
instruction was somewhat more pronounced amongst the workshop sample teachers as compared with the national sample (see Table 4.6 and Figure 4.2). There could be various reasons for this difference. For example, two of the workshop teachers (Müge and Semih) had attended previous workshops where they learned about inquiry instruction. And, regarding grade levels, the workshop teachers favored inquiry approaches at the upper grades somewhat more frequently than the teachers and the national sample.

Research questions 2 through 4 were addressed through the qualitative analysis of interview data from the workshop sample informed by the POSTT-TR quantitative data. The second research question asked: What do teachers’ pedagogical orientations appear to be and what reasons do they give for their pedagogical preferences? The analysis of interview data with respect to this question led to the creation of four teaching orientation categories: Direct Oriented Teachers, Inquiry Oriented Teachers, Mixed Oriented Teachers, and Confused Oriented Teachers. While these categories do not align exactly with the Science Teaching Orientation Spectrum, they are descriptive of both how a teacher responded to the POSTT-TR items and what the teacher said about his or her own classroom instructional practice. In light of the Chapter 2 literature review, it was not surprising that some teachers would have a mixed orientation toward science instructional approaches or that some would be confused. It was also not surprising that some teachers could be identified as primarily oriented toward direct or inquiry instruction. Magnusson et al. (1999) and Friedrichsen et al. (2011) found that while teachers are able to hold multiple orientations, often there is one orientation emphasized over others. Schwartz and Gwekwerere (2007) found that, “…prospective teachers held elements of multiple orientations as evidenced by their lesson plans, but the researchers chose to report only the orientation they thought was dominant” (quoted in Friedrichsen et al., 2011, p.368).
On the other hand, it was difficult to identify two of these teachers’ teaching orientations primarily because they seem to misunderstand the nature of inquiry instructional approaches. As it happens one of these teachers was a novice with only a few years of experience and the other teacher had not come through a formal science teacher education program. These could be factors in their poor understanding of inquiry and their confusion of inquiry and direct instruction approaches. However, while these two teachers were rather extreme, in general the teachers interviewed had only superficial reasons for preferring forms of inquiry instruction (such as promoting student interest in a lesson). Moreover, many of the teachers appeared to have a faulty understanding of inquiry. Often times what they understood as inquiry was a teacher combining student activities with direct instruction.

Nevertheless, the good news from the interview data is that teachers were generally found to prefer inquiry forms of instruction, which confirms the quantitative data findings. It is also good news that some of the teachers appear to be consistent inquiry teachers.

The third research question asked: What contextual factors impact the teachers’ implementation of classroom instructional practices? The findings were that there are indeed factors that inhibit teachers’ instructional choices. Several factors surfaced in the interviews: lack of materials and facilities, time needed to prepare students for the 8th grade standardized test, classroom management concerns especially when the classroom is overcrowded, student origin issues, and school administrator issues. All of the teachers mentioned that time limitations either are or could be a hindrance with respect to using inquiry instruction in practice. Two teachers also mentioned Turkish education policy as obstructing student centered approaches to teaching but that comment is inconsistent with Turkish policy (e.g., TCF 2006, 2013) and was not mentioned by any other teacher. My conclusion was that there was not so much an issue with
That contextual factors might influence teachers’ instructional choices is not surprising as other studies shown similar results. For example, Ramnarain & Schuster (2014) found that various contextual factors influence the methods teachers adopt. These factors included: class size, availability of resources, teacher competence and confidence, time constraints, student ability, school culture and parents’ expectations. Friedrichsen & Dana (2005) also recognized that there could be multiple teaching practices by teachers depending on contextual factors such as grade level, class time, and class size.

Finally, the fourth research question asked: How do teachers explain their actual classroom instructional practices? Here I found that what the teachers had to say during their interviews was fairly consistent with how they responded to the POSTT-TR items. In other words, in responding to the POSTT-TR items the teachers for the most part were thinking about their own instructional practices. However, the consistency was not complete. There were teachers who discussed their actual classroom practices in terms much different from how they responded to the POSTT-TR items. For example, regarding item 9 which is about photosynthesis, Altan preferred the open inquiry instructional approach. The teacher said that “the teacher should observe students’ ideas and how they lead the process and interpret their findings. Therefore, the teacher shouldn’t get directly involved to the activity and conclusion” (lines 4-6). However, the same teacher noted that “I give them homework to test the factors over
the plants. They bring the plants to the classroom and explain what and why happened. If the explanation is correct, I verbally reinforce their success. If they give inadequate explanation, I complete it” (lines 37-39). The data suggests that the POSTT-TR can indeed be quite indicative of what teachers actually do in their classrooms. But some teachers are not accurate assessors of their own practice. The POSTT-TR cannot be a substitute for other sources of data such as classroom observation video records.

5.2 Strengths and Limitations

5.2.1 Strengths

The mixed method design successfully aligned with the purpose of this study. Realistic vignettes of POSTT-TR items concerning specific science concepts provided better understanding and successful reflection of each teacher’s pedagogical orientations and instructional preferences. Moreover, the various science topics from different science areas (Earth Science, Life Science, and Physical Science) improved the validity and reliability of the POSTT-TR assessment instrument. The realistic vignettes across various disciplines of science provided the opportunity for teachers to clearly present their teaching orientation profiles and their instructional preference tendencies. The semi-structured interviews provided beneficial supportive information aligning with the research questions through a well-organized interview protocol.

Moreover, the large national sample strengthen the confidence that the findings are indicative of teachers’ pedagogical profiles, while the smaller interview sample provided critical
information specific to each teacher. Together the data from the samples provided a deeper understanding of Turkish middle school science teachers’ pedagogical orientations and their reasons for four pedagogical practices specific to their actual classrooms.

5.2.2 Limitations

The main limitation of the proposed study is that it relies on teacher self-report data as opposed to actual classroom observational data. It is sometimes difficult to understand how much teachers’ reports reflect their in-class practices.

Another limitation is that the workshop sample was not representative of the national sample. The participants of the workshop were already motivated towards inquiry teaching. This situation could have influenced their explanations and preferences regarding in-class actual practices.

The study is also limited by its specific focus on the teaching of science content. It is clear that many other components such as curriculum, assessment, epistemological beliefs influence teachers’ pedagogical preferences, but these were not the focus of this study.

5.3 Implications

As noted at the start, my research was motivated by changes in the Turkish science curriculum. The Turkish curriculum was revised in 2006 and 2013 by the Ministry of National Education (MoNE) to become more constructivist and with more emphasis on the inquiry teaching of science. Correspondingly, the Turkish Board of Education and Discipline promotes
in-service science teacher training programs on inquiry-based teaching, such as the one feature in my study. The good news for MoNE is that the teachers I studied were more inclined toward inquiry-based instruction than they were to forms of direct instruction. Yet there are also reasons for concern. Upon completion of my research, I have found three significant take away lessons:

1. Teachers in this sample appear to be inclined towards student-centered forms of instruction, and specifically inquiry forms. Of course, the workshop teachers were probably already inclined that way, but it is still good news that they wish to make the effort to improve as more student-centered teachers of science, and to use more inquiry instruction.

2. On the other hand, the teachers do not seem to have thought through why inquiry forms of instruction would be better than direct instruction, and indeed it's not clear that they have an accurate understanding of just what inquiry instruction is. Some of what they describe could be taken as guided inquiry; but sometimes it seems that they think that forms of active direct instruction are forms of inquiry. The teachers need to have a better understanding of exactly what inquiry instruction is and need to have a more professional, informed understanding of the rationale behind instructional approaches.

3. There is absolutely no question that the eighth grade standardized test is a major limitation on the choice of instructional approach. Given that it is unlikely that the tests will be removed, teachers need to learn how to use student-centered instruction in a standardized test environment. Actually, the workshop they were in served a
similar purpose. The workshop was about science inquiry activities that did not require a great deal of time.

5.4 Future Research

The transadapted version of the POSTT dubbed the POSTT-TR worked well in Turkey. I received many positive comments from the teachers who took the POSTT-TR and set for interviews. Some of the instructors who were aware of my research also showed interest in the POSTT-TR. The findings of my own study along with this interest in the POSTT-TR suggest that studies should be done with extended teacher samples, such as elementary teachers. Following Ramnarain & Schuster (2014), there are regions of Turkey with sufficient differences to make a comparison of teachers from different regions interesting.

The POSTT was originally developed as a formative assessment device, and my study indicates that speaking with teachers (whether pre-service or in-service) about POSTT-TR responses can be helpful with respect to the development of teachers’ teaching orientations and instructional practice decisions, perhaps especially for novice teachers. At this point, this study showed that some POSTT-TR items could be used for classroom discussion as a formative assessment tool in teacher education programs. Instructors of science methods courses may be able to benefit from these items for their pre-service science teachers.
REFERENCES


152


National Research Council (2003). *What Is the Influence of the National Science Education Standards? Reviewing the Evidence, A Workshop Summary.* Karen S. Hollweg and David Hill. Steering Committee on Taking Stock of the National Science Education Standards: The Research, Committee on Science Education K-12, Center for Education, Division of


Appendix A

Human Subjects Institutional Review Board Approval and Consent Form
Date: August 15, 2016

To: William Cobern, Principal Investigator
    Selezuk Sahingoz, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 16-08-03

This letter will serve as confirmation that your research project titled “An Investigation of Turkish In-Service Middle School Science Teachers’ Pedagogical Orientations Towards Direct and Inquiry Instructional Approaches” has been approved under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under “Number of subjects you want to complete the study.”) Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: August 14, 2017
Survey Consent Form
Western Michigan University
Mallinson Institute for Science Education

Principal Investigator: William W. Cobern, PhD
Student Investigator: Selcuk Sahingoğlu
Title of Study: An Investigation of Turkish In-Service Middle School Science Teachers' Pedagogical Orientations towards Direct and Inquiry Instructional Approaches

You are invited to participate in a research project titled "An Investigation of Turkish In-Service Middle School Science Teachers' Pedagogical Orientations towards Direct and Inquiry Instructional Approaches." This consent document will explain the purpose of this research project and will go over the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?
The purpose of the study is to gain a broad understanding of Turkish middle school science teachers' pedagogical orientations by considering their instructional preferences, their explanations for their pedagogical preferences, and factors affecting their preferences.

Who can participate in this study?
Any Turkish middle school science teacher is eligible to participate in this research.

Where will this study take place?
Teachers will receive a survey at their schools and can complete them at their convenience.

What is the time commitment for participating in this study?
Completion of the survey will take approximately 30 minutes.

What will you be asked to do if you choose to participate in this study?
If you choose to participate in this study, you will be asked to complete the "Fen Öğretimi Özerine Düşünmek" survey. All of the questions are about science teaching strategies. There are no right or wrong answers. The survey does not ask for any personal information.

What information is being measured during the study?
The survey data for each participant will be compiled as a profile indicating science pedagogical preferences (or orientation).
What are the risks of participating in this study and how will these risks be minimized?
The only known risks for this type of research are possible minor discomforts such as boredom. Given that the data collection is completely anonymous, the risk of anyone knowing of your participation is minimal.

What are the benefits of participating in this study?
There are no known direct benefits to you who participate in the research, other than they would be reading many science concepts scenarios related with science teaching. The benefit of participating in this study includes satisfaction of helping to find out and improve professional development of middle school science teachers.

Are there any costs associated with participating in this study?
The only cost is the time needed for the survey.

Is there any compensation for participating in this study?
There is no compensation for participating in this study.

Who will have access to the information collected during this study?
The data from this study will be used for the student investigator’s doctoral dissertation and related publications. Only the principle investigator and the student investigator will have access to the information collected during this study. All data and coding information will be kept in a locked cabinet in the principle investigator’s office at WMU for at least three years after completion of the study. All information will be kept confidential. Pseudonyms will be used in any published document or professional meeting reports.

What if you want to stop participating in this study?
You can choose to stop participating in the study at anytime for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either vocationally or personally if you choose to withdraw from this study. The investigator can also decide to stop your participation in the study without your consent.

Should you have any questions prior to or during the study, you can contact the primary investigator, William W. Cobern at +1 (269) 387-5407 or bill.cobern@wmich.edu. You may also contact the Chair, Human Subjects Institutional Review Board at +1 269-387-8293 or the Vice President for Research at +1 269-387-8298 if questions arise during the course of the study. This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

Submitting a completed survey indicate that you have read this informed consent document and agree to take part in this study.
Workshop Survey and Interview Consent Form
Western Michigan University
Mallinson Institute for Science Education

Principal Investigator: William W. Cobern, PhD
Student Investigator: Selcuk Sahingoz
Title of Study: An Investigation of Turkish In-Service Middle School Science Teachers' Pedagogical Orientations towards Direct and Inquiry Instructional Approaches

You are invited to participate in a research project titled "An Investigation of Turkish In-Service Middle School Science Teachers' Pedagogical Orientations towards Direct and Inquiry Instructional Approaches." This consent document will explain the purpose of this research project and will go over the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?
The purpose of the study is to gain a broad understanding of Turkish middle school science teachers' pedagogical orientations by considering their instructional preferences, their explanations for their pedagogical preferences, and factors effecting of their preferences.

Who can participate in this study?
The participants who took “Fen Öğretimi Üzerine Düşünmek” survey and indicated willingness to sit for a follow-up interview related to the survey.

Where will this study take place?
Data collection will take place in Muğla Sitki Koçman University, Turkey.

What is the time commitment for participating in this study?
Completion of the survey will take approximately 30 minutes and completion of the interviews will take no more than 60 minutes.

What will you be asked to do if you choose to participate in this study?
If you choose to participate in this study, you will be asked to complete the “Fen Öğretimi Üzerine Düşünmek” survey and sit for an interview. All of survey questions are about science teaching strategies. There are no right or wrong answers. The survey does not ask for any personal information. At the interview, you will be shown the “Fen Öğretimi Üzerine Düşünmek” survey and asked to explain your pedagogical choices. The interviews will be audio recorded.
What information is being measured during the study?
The survey data for each participant will be compiled as a profile indicating science pedagogical preferences (or orientation). The interviewees' audiotaped explanations help better understand reasons for pedagogical choices in science education.

What are the risks of participating in this study and how will these risks be minimized?
There are no known risks for this type of study other than the possible minor discomforts someone might feel while being interviewed (e.g., boredom, mild stress owing to the interviewing situation) and the possibility that the data will not be anonymous. You are free to discontinue participation at any time and for any reason. Anonymity will be protected in that only the investigators will have access to the consent forms and the data. Once the audio tapes have been transcribed and matched with surveys, all names will be removed and the audiotapes destroyed. All reports will use pseudonyms to protect the teachers' identities. Any other identifying data will be disguised or removed.

What are the benefits of participating in this study?
There are no known direct benefits to you who participate in the research, other than you would be reading many science concepts scenarios related with science teaching. The benefit of participating in this study includes satisfaction of helping to find out and improve professional development of middle school science teachers.

Are there any costs associated with participating in this study?
The only cost is the time needed for the survey and the interviews.

Is there any compensation for participating in this study?
There is no compensation for participating in this study.

Who will have access to the information collected during this study?
The data from this study will be used for the student investigator's doctoral dissertation and related publications. Only the principle investigator and the student investigator will have access to the information collected during this study. All data and coding information will be kept in a locked cabinet in the principle investigator's office at WMU for at least three years after completion of the study. All information will be kept confidential. Pseudonyms will be used in any published document or professional meeting reports.

What if you want to stop participating in this study?
You can choose to stop participating in the study at anytime for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either vocationally or personally if you choose to withdraw from this study. The investigator can also decide to stop your participation in the study without your consent.

Should you have any questions prior to or during the study, you can contact the primary investigator, William W. Cobern at +1 (269) 387-5407 or bill.cobern@wmich.edu. You may also
contact the Chair, Human Subjects Institutional Review Board at +1 269-387-8293 or the Vice President for Research at +1 269-387-8298 if questions arise during the course of the study. This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

Submitting a completed survey and indicated willingness to sit for a follow-up interview related to the survey that you have read this informed consent document and agree to take part in this study.

Please Print Your Name

Participant's signature						Date
Appendix B

POSTT Assessment Instrument (English Version)
Thinking about Science Teaching

Dear Teachers:

This assessment is composed of classroom science teaching vignettes similar to teaching practices one can find in any classroom today. Practicing teachers contributed ideas for many of the vignettes; others are based on teacher observations, or on science curriculum standards.

As you read each vignette, think about how you might teach science in a similar situation. Respond accordingly.
1 - Lesson on force and motion

Ms. Brandt is preparing a lesson to introduce her 5th grade students to the relationship between force and motion, namely that a net force will cause an object to speed up or slow down (Newton’s 2nd Law). The classroom has available a loaded wagon to which a pulling force can be applied. Ms. Brandt is considering four different approaches to the lesson.

Thinking about how you would want to teach this lesson, of the following, which one is most similar to what you would do?

A. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully to my students. Then I would demonstrate the law by pulling on a loaded wagon with a constant force in front of the class as they observe the motion.

B. Raise the question of what kind of motion results from a constant force. I would then guide my students to explore the question themselves by pulling on a loaded wagon and observing what happens. From the evidence they would then propose a possible law.

C. Write a clear statement of Newton’s 2nd Law on the board and explain it carefully to my students. I would then have the students verify the law by pulling on a loaded wagon themselves and confirming what type of motion results.

D. Raise the question of whether there is any relationship between force and motion. My students would then be free to explore this safely in the lab. Afterward we would have a class discussion of their findings.
2 - General wrap-up of unit

Mr. Nelson’s 6th grade students have just completed a unit in their earth science class. As a “wrap-up,” Mr. Nelson would like students to re-examine the three learning objectives that served as the focus for this entire unit.

Of the following, which is most similar to how you would like to conduct the wrap-up?

A. I would ask the students what the main things are that they have learned in the unit, according to their own ideas of what is important or interesting, and have them list these as the unit wrap-up.

B. I would restate the three learning objectives for the students, and then relate each of them to the specific concepts that arose in the unit.

C. I would ask the students to reflect back on their work, and identify for themselves what the important central ideas of the unit were, then have them relate these to the original learning objectives.

D. I would restate the three learning objectives, then ask the students to say how the various concepts that arose in the lesson related to each of these.
3 - Sundial

Ms. Navetta is planning a 7th grade lesson on the changing position of the sun in the sky during the day and how this is the basis of a simple ‘sundial’ to tell time of day. The basic sundial is a simply a vertical stick on a piece of board, and in sunlight the angle of the stick’s shadow can be marked on the board. Ms. Navetta also has a larger demonstration model with lines marked at various angles and labeled with hour of day.

Ms. Navetta considers various ways to conduct the lesson. Of those below, which is most similar to how you would teach?

A. Explain how a sundial works related to sun position in the sky. Have each group assemble a basic sundial, using a prepared handout sheet with lines and hour markings. Then take the students outside to try out their sundials and see that they indicate the correct time of day.

B. Do not explain sundials but take the students outside and have each group set up a stick and board. Ask them to brainstorm what this might be useful for, and to expand on their ideas. Have them come back every hour, anticipating that they will mark a series of shadow lines to make a sundial.

C. Explain how a sundial works, in relation to sun position in the sky. Then gather the class outside around the demonstration model, so they can see how the sundial indicates the correct time of day. Come back an hour later to see that the shadow has moved to the next marking.

D. Instead of explaining sundials take the students outside and note the location of the sun in the sky. Have each group set up a stick and board and mark the position of the shadow. Ask them to suggest how this might be used as a ‘shadow clock’ to tell time of day. Have them come back every hour and mark a new shadow angle, labeling it with the hour, to make a sundial.
4 - Predator and prey

Mr. Peoples is conducting a unit on food chains and is about to introduce his 7th grade students to predator/prey relationships. He has a good computer simulation game for this subject that he can use with his class.

Thinking about how you would teach this lesson, of the following, which is the best advice for conducting this lesson?

A. Mr. Peoples should begin by asking the students what they know about predators and prey. Without responding other than to encourage their ideas, Mr. Peoples should then show them the computer simulation game he has for this subject and invite them to use the simulation in any way they wish to explore their ideas. The lesson would end with students writing up their findings.

B. Mr. Peoples should explain to his students that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population of the same region. Using the computer simulation game, he should have the students monitor and record the rabbit levels over a simulated ten-year period during which the population of coyotes rises and falls, so that they can confirm the predator/prey concept he explained.

C. Mr. Peoples should ask what would happen with rabbits if many coyotes died suddenly of disease. After some discussion, Mr. Peoples should suggest that the students explore their ideas using the computer simulation game he has for this subject, by recording yearly counts over a simulated period of ten years. The students will then have data to be used in a class discussion on predator/prey relationships.

D. Mr. Peoples should explain to his students that balance typically exists in nature such that the numbers of predators and their prey are related. For example, he can tell them that a rabbit population will increase if disease reduces the coyote population in the same region. He should then project the simulation game to demonstrate relationships between rabbit and coyote populations.
5 - What does a thermometer do?

Mr. Dole plans to introduce the use of thermometers to his 5th grade students. He has common thermometers and materials that can be assembled to make basic thermometers (small bottles, corks with holes, straws and colored water). Mr. Dole considers different ideas for teaching the lesson.

Thinking about how you would teach, of the following, which one is most similar to the approach you would take?

A. I would tell my students that today I have materials (small bottles, corks with holes, straws and colored water) that I want them to assemble a device following some simple instructions. Once they had assembled their devices, I would have them observe and record what happens when they alternately place their bottles in cold and hot tap water, asking the students if they could think of anything that works similar to their devices. We would then have a discussion of their findings after which I would explain that like the model the mercury in a real thermometer rises and falls with temperature changes.

B. I would begin by writing the lesson title ‘Thermometers’ on the board. Then I would give the students preassembled thermometers and direct them to observe what happens when they alternately dip their bottles into hot and cold tap water. Showing a common thermometer, I would then explain that like their models, the fluid in a common thermometer varies with temperature changes.

C. I would write the lesson title ‘Thermometers’ on the board and then demonstrate the assembly of a small bottle, cork with hole, straw and colored water into a basic thermometer. By alternately dipping the bottle into hot and cold tap water, I would show the colored water rising and falling. Showing a common thermometer, I would explain that like the model the fluid in a common thermometer varies with temperature changes.

D. I would start by telling the class that today they will investigate using a device they build with small bottles, corks with holes, straws and colored water. I will also give them assembly instructions and suggest that they dip their bottles alternately in cold and hot tap water, and record their observations. The lesson would conclude with students writing about the activity and what might be learned from their observations.
Mr. Hamid would like his 8\textsuperscript{th} grade class to explore the concept of sand erosion as a function of water volume. He has available stream tables, which can be used to illustrate this by taking measurements of sand height at various points before and after adding water. Mr. Hamid also has a film clip that explicitly explains and illustrates the erosion process. He is unsure which of these to use, and when.

Thinking about how you would teach this lesson, of the following, which is most like how you would structure this lesson?

A. I would begin the lesson by having the students investigate sand erosion by doing the stream table activity, followed by a class discussion of their observations. Then I would use the film clip to bring closure to the lesson.

B. I would begin the lesson by having students explore with the stream tables, and then have them discuss what they discovered. The lesson would revolve around the students’ explorations and conclusions, and not include the film.

C. I would begin the lesson with the film clip and explain to the students how sand erosion is a function of water volume. Then I would demonstrate this using the stream table, calling the students’ attention to what they saw in the film clip and are now observing in the stream table demonstration.

D. I would begin the lesson with the film clip. Then I would have had the students do the water table activity so that they could see water erosion and the effect of water volume firsthand.
7 - Light reflection

Ms. Baker is teaching her 8th grade students the law of reflection: when a ray of light strikes a mirrored surface, it leaves at the same angle as when it arrived. Ms. Baker has to decide how she will teach the lesson.

Thinking about your own teaching, of the following, which is most similar to how you would teach the lesson?

A. I would write the law of reflection on the board and illustrate with a diagram. Then, I'd have the students verify the law using light ray sources, mirrors, and protractors. We would then discuss their findings.

B. I would ask students to find out what they can about light behavior around mirrors by exploring on their own with an assortment of available items, including light ray sources, mirrors, and protractors. Then the students would report back on what they did and what they found out.

C. I would first pose a question about reflection for the students to explore. The students could investigate using light ray sources, mirrors, and protractors, and then discuss their findings. I would close the lesson by giving them a summary of the law of reflection.

D. I would write the law of reflection on the board and illustrate with a diagram. Next I'd show them a real example, using a light ray source, mirror, and protractor. Then we would discuss any questions the students might have.
8 - Acid indicator

Mr. Jawswiki is preparing chemistry lessons for his 8th graders. Online, he found that red cabbage juice can be used to determine if a household chemical is acidic or basic. At 7th grade, the only concept that can be associated with this activity is that when some chemicals mix with acids or bases, there is a visible physical change (such as a color change), so we call such chemicals “indicators.” Mr. Jawswiki is not sure how he might use the activity or if he should at all.

Thinking about how you would teach, of the following, which is most similar to how you would advise Mr. Jawswiki.

A. He should clearly explain the importance of indicators in chemistry. He should then demonstrate how this works by using the cabbage juice showing them the color change with an acid (vinegar) and a base (detergent)

B. He should clearly explain the importance of indicators in chemistry. He should then have students observe the changes that take place in cabbage juice using a variety of household chemicals.

C. Mr. Jawswiki should have his students add several known household chemicals to red cabbage juice, with the goal of seeking out patterns in what they see. After discussing their observations, Mr. Jawswiki should explain the concept of indicators and their importance in chemistry.

D. Mr. Jawswiki should give his students red cabbage juice along with several known and unknown household items. He should have students test the known chemicals with the red cabbage juice, with the goal of identifying the unknowns.
Ms. Hamid has been teaching her 8th grade students about photosynthesis and in particular that chlorophyll production in plant leaves is light-induced. She sets up an example to illustrate this. She has placed fast-growing seedlings where they are exposed to different levels of light intensity. The students observe the growing plants over several days and estimate the amount of chlorophyll using a color chart to record leaf color. They record their data in their science notebooks and on a classroom data table. On the last day, Ms. Hamid reviews the role of light in chlorophyll production as illustrated by the activity.

Thinking about how you would teach this topic, of the following, which is the best evaluation of her lesson?

A. This is a good lesson design overall because Ms. Hamid begins with an explanation of the concepts she wants the students to learn followed by an activity for students to confirm that chlorophyll production is light-induced.

B. Ms. Hamid begins appropriately with an explanation of the concepts she wants the students to learn. This being so, it is not clear that the activity is needed, especially since it requires so much class time.

C. Ms. Hamid’s approach is too pre-organized and prescriptive. It would be better for students themselves to decide how to set up plants and lights, see what happens, and figure out a way to compare chlorophyll production in the leaves.

D. The instructional sequence would be better if the students do the plant observations first, showing that chlorophyll is light-induced, after which Ms. Hamid can explain the process more fully.
**Moon in the daytime**

Ms. Luna had taught her 8th grade students how the phases of the moon are due to its illumination by the sun at different angles. As part of her lesson she used the picture shown, illustrating how the various phases look at night. Toward the end of the lesson one student Max looks out the window at the sky. He is surprised: he excitedly tells Ms. Luna he can see the moon but it is daytime! He is puzzled and asks how that can be. Ms. Luna wants to use this as a ‘teachable moment’ to enhance their understanding of how moon phases arise. She congratulates Max on his observation and has everyone go outside to look before coming back in.

Thinking about how you would teach, how would you suggest Ms. Luna continue when back in the classroom?

A. Throwback Max’s question to the students: ask them to explain the observation by drawing sky diagrams for that day showing moon and sun and applying what they have learned about light and illumination.

B. Tell the class there is no reason that the moon cannot be seen in the daytime. Then ask students to apply what she has taught them and draw diagrams showing how the moon is being illuminated by the sun that particular day.

C. Tell the class there is no reason that the moon cannot be seen in the daytime. Then draw a sky diagram on the board showing how the moon is being illuminated by the sun that particular day.

D. Throwback Max’s question to the students: have them come up with ideas and possible explanations and report these to the class, followed by discussion.

Thank you for taking the time to complete this survey 😊
Appendix C

POSTT Assessment Instrument Answer Key
### Answer Key

<table>
<thead>
<tr>
<th>Lesson on force and motion</th>
<th>Stream table</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Didactic Direct (DD)</td>
<td>A. Didactic Direct (DD)</td>
</tr>
<tr>
<td>B. Guided Inquiry (GI)</td>
<td>B. Open Inquiry (OI)</td>
</tr>
<tr>
<td>C. Active Direct (AD)</td>
<td>C. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>D. Open Inquiry (OI)</td>
<td>D. Active Direct (AD)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>General wrap-up of unit</th>
<th>Light reflection</th>
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</thead>
<tbody>
<tr>
<td>A. Open Inquiry (OI)</td>
<td>A. Didactic Direct (DD)</td>
</tr>
<tr>
<td>B. Didactic Direct (DD)</td>
<td>B. Open Inquiry (OI)</td>
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<tr>
<td>C. Guided Inquiry (GI)</td>
<td>C. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>D. Active Direct (AD)</td>
<td>D. Active Direct (AD)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Sundial</th>
<th>Acid indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Active Direct (AD)</td>
<td>A. Didactic Direct (DD)</td>
</tr>
<tr>
<td>B. Open Inquiry (OI)</td>
<td>B. Active Direct (AD)</td>
</tr>
<tr>
<td>C. Didactic Direct (DD)</td>
<td>C. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>D. Guided Inquiry (GI)</td>
<td>D. Open Inquiry (OI)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Predator and prey</th>
<th>Photosynthesis</th>
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<tr>
<td>A. Didactic Direct (DD)</td>
<td>A. Active Direct (AD)</td>
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<td>B. Active Direct (AD)</td>
<td>B. Didactic Direct (DD)</td>
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<td>C. Guided Inquiry (GI)</td>
<td>C. Open Inquiry (OI)</td>
</tr>
<tr>
<td>D. Open Inquiry (OI)</td>
<td>D. Guided Inquiry (GI)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What does a thermometer do?</th>
<th>Moon in the daytime</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Didactic Direct (DD)</td>
<td>A. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>B. Active Direct (AD)</td>
<td>B. Active Direct (AD)</td>
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<tr>
<td>C. Guided Inquiry (GI)</td>
<td>C. Didactic Direct (DD)</td>
</tr>
<tr>
<td>D. Open Inquiry (OI)</td>
<td>D. Open Inquiry (OI)</td>
</tr>
</tbody>
</table>
Appendix D

POSTT-TR Assessment Instrument (Turkish Version)
FEN ÖĞRETİMİ ÜZERİNE DÜŞÜNMEK

ORTAOKUL FEN BİLİMLERİ ÖĞRETİNMENLERİİNİN ÖĞRETİM YAKLAŞIMLARINA YÖNELİK PEDAGOJİK ORYANTASYONLARININ ARAŞTIRILMASI

Selçuk Şahingöz
Doktora Tezi Anket Çalışması

Michigan
Eylül 2016
Sevgili Öğretmenler,

Bu değerlendirme, kendi sınıflarınızda karşılaşılabileceğiniz sınıf içi öğretim uygulamalarıyla benzerlik gösteren Fen Öğretimi örnek olaylarından oluşmaktadır. Bu örnek olayların büyük bir kısmı öğretmenlerin görüşleriyle hazırlanmış olup bir kısmı da öğretmen gözlemlerine ya da Fen Bilimleri Öğretim Programı standartlarına dayalı olarak oluşturulmuştur.

Her bir örnek olayı okurken, benzer bir durumda fen bilgisi dersinin konularını hangi şekilde öğretebileceğinizi düşünüp size en uygun olan seçeneği işaretleyiniz.
Kişisel Bilgiler

1. Cinsiyet
   ○ Kadın  ○ Erkek

2. Mezun Olduğunuz Alan
   ○ İlköğretim Fen Bilgisi Eğitimi
   ○ Ortaöğretim Fizik Eğitimi
   ○ Ortaöğretim Kimya Eğitimi
   ○ Ortaöğretim Biyoloji Eğitimi
   ○ Diğer .................................

3. Hizmet Süresi (yıl)
   ○ 1-2  ○ 3-5  ○ 5+

4. Çalıştığınız Okul Türü
   ○ Devlet Okulu  ○ Özel Okul (Kolej vb.)
   ○ Diğer .................................

5. Öğretim Yaptığınız Sınıflardaki Ortalama Öğrenci Sayısı:

Sorular

1. Kuvvet ve Hareket Konusuyla İlgili Ders


Bu dersi nasıl işleme istediğinizinizi düşündüğünüzde, aşağıdaki yöntemlerden hangisi sizin yapacağınızı en yakın olandır?


B) ‘Sabit kuvvet nasıl bir harekete yol açar?’ sorusunu yönetin. Bunun ardından yükülü vagonu çekerek ve ne olduğunu gözlemleyerek öğrencileri tek başına soruyu incelemeye yönlendirin. Kanıttan yola çıkarak olası bir kanun ortaya koyabilirsiniz.


2. Ünite'nin Genel Özeti

Burhan Öğretmen'in, 6. sınıf öğrencileri, yerbilimlerinden bahseden bir üniteyi henüz tamamlamışlardır. Burhan Öğretmen, konuyu topal-

lamak ve özetlemek için, öğrencilerinden bu ünite'nin odak noktasi

olan üç öğrenme kazanımını yeniden incelemelerini istemektedir.

Dersi özetlemek için aşağıdaki kilerden hangisi sizin yapmak iste-

yeciniz?”

A) Öğrencilere ünite'den esas olarak neler öğrendiklerini, kendi görüşleri-

ne göre nelerin önemli ya da ilginc olduğunu sorardım ve onlardan bunları ünite özet olarak listelemelerini

isterdik.

B) Öğrenciler için üç öğrenme kazanımı yeniden ifade ederdim ve bunun ardından her birini ünite öne-

kär-fıklarla belirli kavramlarla ilişkilendirirdim.

C) Öğrencilerden çalışmalarını üzerine düştürenleri ve ünite'nin kendi

leri için önemli ana fikirleri tanımlama-

lara ve bunları asıl öğrenme amaçları ile ilişkilendirmelerini isterdik.

D) Úç öğrenme amacı'nı yeniden ifade ederdim; bunun ardından öğrencilerden derste ortaya çıkan çeşitli

kavramların her birine nasıl ilgili olduğunu gösteren bir zihin haritası/kavram haritası çizmelerini isterdik.

3. Güneş Saati

Bir parça karton üzerinde dikey bir çubuğun olduğu basit bir Güneş saati, Güneş ışığı ile bu çubuğun gölgesi arasındaki açının karton üzerinde işa-

retlenmesiyle oluşturulabilir. Emel Öğretmen Güneş'in gösterdiği gün boyunca komu

boynuzun ağırlığının ve bunun gününü vaktini söylenebilen basit bir Güneş saati olarak nasıl kullanılabileceğini gösteren bir 5. sınıf der-

si planlıyor. Ayrıca, Emel Öğretmen çeşitli açları çizgilerle işaretlenmiş olduğu ve gününün saatleri ile etiketlenmiş olan daha geniş bir gösteri mo-

deline de sahiptir.

Emel Öğretmen bu dersin işlenmesi için çeşitli yöntemleri göz önünde bulundurduktadır. Bu ko-

nuyu nasıl öğretmecinin yöntemi aşağıdaki yöntemlerden hangisi size en yakını olurdu?

A) Bir Güneş saatinin nasıl çalıştığını Güneş'in gösterdiği komumuyla ilişkilendiren açıklamalar. Üzerinde

cizgiler ve saat işaretilerinin bulunduğunu hazırlamış bir çalışma yaparak onlar, gününün doğru zamanını işaretleyip işareti
deklereki kontrol ederim.

B) Güneş saatlerini açıklamam fakat öğrencileri dışarı çıkarmış orm ve her bir grubu bir çubuk ve karton veririm. On-

lardan bu malzemelerin ne için kullanılabileceği ve kendisi fişlerine nasıl geliştirileceğini h sorusunda

beşin fırınıracı yapmaklarını isterim. Bir Güneş saatı yapmak için her saatte bir geri gelip bir dizi gelge hatti

cizeceklerini ağırlamalarını bekerim.

C) Güneş'ın gösterdiği komunuyla ilişkilidir olarak bir Güneş saatinin nasıl çalıştığını açıklamalar. Ona Gü-

neş saatinin gününün zamanını söyleyen bir “göle saati” olarak nasıl kullanılabileceğini göstermek istiyorum. Bir Güneş saatı yapmak için her saatte bir geri gelip yeni bir gelge açısı işaretlemelerini ve bunu saat etiketlemelerini isterim.
4. **Av ve Avcı**

Besin zincirleri üzerine bir ünite işlemekte olan Özgül Öğretmen, 8. sınıf öğrencilerine av-avcı ilişkilerini anlatmak üzere, Bu konuya ilgili olarak derste kullanabileceği iyi bir bilgisayar benzetim (simülasyon) oyunu da sahiptir.

Bu dersi nasıl işleyeceğini düşünüңüzde, aşağıdakiilerden hangisi sizce bu dersin işlenmesi için en iyi önerilerdir?

A) Özgül Öğretmen, öğrencilerine doğada genel olarak avcılann ve avların sayısının birbirine bağlı olduğu bir denenin bulunduğu açıklamalıdır. Örneğin, Özgül Öğretmen bir bölgedeki tilki nüfusunun hastalığı bağlı olarak azalmış halinde, aynı bölgedeki tavşan nüfusunun artacağıni öğrencilerle söyleyebilir. Bunun ardından tavşan ve tilki nüfusları arasındaki ilişkileri göstermek için benzetim oyununu sunmalıdır.

B) Özgül Öğretmen, öğrencilerine doğada genel olarak avcılann ve avların sayısının birbirine bağlı olduğu bir denenin bulunduğu açıklamalıdır. Örneğin, Özgül Öğretmen bir bölgedeki tilki nüfusunun hastalığı bağlı olarak azalmış halinde, aynı bölgedeki tavşan nüfusunun artacağıni öğrencilerle söyleyebilir. Bilgisayar benzetim oyununu kullanarak, tilkilerin nüfusunun (popülasyonunun) artıp azaldığı on yıllık temsili bir süreçte öğrencilerin tavşan saylarının izlemelerini ve kaydetmelerini sağlamalıdır, böylece öğrenciler Özgül Öğretmen’in açıklamış olduğu av/avcı kavramını doğrulayabilir.

C) Özgül Öğretmen, birçok tilkinin hastalıktan dolayı aniden ölmesi durumunda, tavşanlara ne olacağını sormalıdır. Bu konuda yapılan kisa bir tartışmanın ardından, Özgül Öğretmen, öğrencileri ellendeği bilgisayar benzetim oyununu kullanarak on yıllık temsili bir süreçte yeni可怜 sonucunun kaydetmelerini ve av-avcı arasındaki ilişkiye ait sonuca varamalarını önermelidir. Böylece, öğrenciler, av/avcı ilişkilerini konusundaki bir sınıf tartışmada kullanacak verileri sahip olacaklardır.

D) Özgül Öğretmen, derse öğrencilerce avcılann ve avlar hakkında ne bildiklerini sorarak başlamalıdır. Özgül Öğretmen, öğrencisi fikirlerini teşvik etmeye yönelik olduğu sürec onların sorularına cevap vermelidir. Bu konuya ilgi elinde olan benzetimi oyununu göstermeli ve kendi fikirlerini keşfetmeyi arzu ettiklerini bir yönetimde onları benzetimden yararlanmaya davet etmelidir. Ders, öğrencilerin bulgularını yazmaları ile sona ermelidir.
5. Termometre Ne İşe Yarar?

Salih Öğretmen 8. sınıf öğrencilerine termometrelerin kullanımını öğretmeyi planlıyor. Salih Öğretmen’in bilindik termometreleri ve termometrelerin oluşturduğu tepki terval malzemeleri (küçük şişeler, delikli mantar tipalari, pipetler ve renkli su) bulunmaktadır. Salih Öğretmen konuyu öğretmek için farklı fikirleri dikkate almaktadır.

Bu dersi nasıl işleyeceğinizi düşündüğünze, aşağıdaki yöntemlerden hangisi sizin bu dersi işleme çekliniz-yaklaşımınızda en yakın olanıdır?

A) Tahtaya konu başlığı olarak “Termometreler” yazarak ve sonra öğrencilerle küçük şişeyi, delikli mantar tipayı, pipet ve renkli suyuyu basit bir termometrede nasıl bir araya getireceklərini gösterir. Şişeyi sırasıyla sıcak ve soğuk suyu suyunu batıracak renkli suyun iniş çıkışı gösterir. Bilindik bir termometre gösterecek modeldeki gibi bir termometrelinin içindeki sıvının sıcaklık değişimi ile farklılaşmasını açıklar.

B) Tahtaya konu başlığı olarak “Termometreler” yazarak derse başlarım. Sonra öğrencilere önceden birleştirmiş termometreler verir ve onları öğrencilerinin sırasıyla sıcak ve soğuk suyu suyunu batırdıklarında ne olduğunu gözlêmlemeye yönlendirir. Bilindik bir termometre gösterdikten sonra modellerindeki gibi bir termometrelinin içindeki sıvının sıcaklık değişimi ile farklılaşmasını açıklar.

C) Öğrencilere bugün bazı basit tahlilatlan izleyerek bir cihaz oluşturmak için malzemelerin (küçük şişeler, delikli mantar tipalari, pipetler ve renkli su) olduğunu söyler. Cihazları oluşturunca onlardan öğrencileri sırasıyla sıcak ve soğuk suyu suyunu tuttuklara ne olduğunu gözlêmlemelerini ve kaydetmelerini ister. Öğrencilere kendilerindechi cihazlarında benzer şekilde başka bir şey düşünüyörlerse yapmalarını söylerim. Bulgularıyla ilgili tartışma yaratdırktan sonra gerçek bir termometrede civanın sıcaklık değişimi ile inip çıktığı modeli açıklar.

D) Bugün küçük şişeler, delikli mantar tipalari, pipetler ve renkli suyu oluşturulacak bir cihazını öğrencilerin araştıracakları sinif söyleyerek derse başlarım. Onlara kuruluşun nasıl yapılacağını da açıklarım ve öğrencileri sırasıyla sıcak ve soğuk suyu suyunu batırdıkları ve gözlêmelerini kaydetmelerini tavsiye ederim. Dersi öğrencilerin aktiviteyle ilgili raporlarını ve gözlêmelerinden en önemlisiiletleyerek sonlandırım.

6. Akarsu Masası

Bülent Öğretmen 5. sınıf dersinde öğrencilerinin su hacminin bir işlevi olarak kum erozyonu kavramını keşfetmesini ister. Bülent Öğretmen’in bu konu öngelendirmek için su eklemenden önce ve ekledikten sonra çeşitli noktalardaki kum yüksekliklerinin ölçümlerini almakta kullanılabileceği uygun akarsu masaları vardır. Ayrıca, Bülent Öğretmen erozyon sürecini açık bir şekilde anlatan ve öngelendiren bir gösteri filme de sahiptir. Ancak bunlardan hangisini ne zaman kullanacağından emin değildir.

Bu dersi nasıl işleyeceğiniz düşündüğünze, aşağıdaki yöntemlerden hangisi sizin bu dersi nasıl düzenlemek ıdetediniz en yakın olanıdır?

A) Ders filmline başlarırm ve öğrencileri kum erozyonunun su hacminin bir işlevi olduğunu açıklarım. Sonra öğrencilerin filminde ne gördüklerini ve akarsu masası gösterimindeki gözlêmelerine dikkat çekerek, bunu akarsu masasını kullanarak gösteririm.


C) Dersin başında öğrencileri akarsu masası etkinliğini yap_trampoline kum erozyonunu inceleterim ve devamından da gözlêmelerile ilgili bir sinif tartışması yapmalarını isterim. Sonra filmi kullanarak dersi bitiririm.

D) Ders filmline başlarım. Sonra öğrencileri su masası etkinliğini yaptrim; böylece su erozyonunun ve su hacminin etkisini kendileri görebilirler. 

185
7. **Işıkın Yansıması**

Eralp Öğretmen, 6. sınıf öğrencilerine yansıma kanununu; bir ışık ışını aynalı bir yüzeye çarpığından, geldiği aça ile yansımaca eğilimde öğretmektedir. Eralp Öğretmen, bu dersi nasıl işleyebileceğini karar vermelidir.

Kendi ders işleme yönteminiz düşündüğünüzde, sizin yöntemine en yakın olanı aşağıdaki kilerden hangisidir?

A) Tahtaya yansıma kanununu yazdığım ve bir şema ile gösterirdim. Bunun ardından bir ışık kaynağı, ayna ve açıqlar kullanarak gerçek bir örneğ gösterirdim. Sonra öğrencilerin sorularını ele alarak tartıştım.

B) Öğrencilerin ışık kaynakları, aynalari ve açıqları içeren mevcut materyaller yardımıyla kendi başlarına ışık işinlerinin aynadaki yansımasının nasıl olduğunu bulmalarını isterdim. Bunun ardından öğrenciler ne yaptıklarını ve ne buldularını rapor ederlerdi.

C) Öncelikle öğrenciler, dersimleri için yansıma hakkında bir soru bağlantı. Öğrenciler, ışık kaynaklarını, aynalari ve açıqları kullanarak araştırır ve sonrasında da bulgularını tartıştılar. Dersi yansıma kanunu özelleyerek sonlandırdım.

D) Tahtaya yansıma kanununu yazdım ve bir şema ile gösterirdim. Bunun ardından ışık kaynakları, aynalar ve açıqlar yangın veya öğrencilerin kanunu doğrulamalarını sağlAMD. Sonrasında da onların bulgularını tartıştık.

8. **Asit Ayraç (İndikatörü)**


Bu dersi nasıl işleyebileceğiniz düşündüğünüzde, aşağıdaki kilerden hangisi Muammer Öğretmen'e tavsiye edeceğiniz en yakın olanıdır?

A) Net bir şekilde ayraçların kimyaagnitudemini açıklamalıdır. Sonra bunun nasıl gerçekleştiğini kırmızı lahana suyunu kullanarak ve renk değişimini bir asit (sirke) ve bir baz (deterjan) ile göstererek onlara ispatlama.
9. Fotosentez


Bu konuyu nasıl işleyeceğinizi düşündüğünüzde, aşağıdaki durumda hangisi size Yelda Öğretmen'in dersinin en iyi değerlendirme olur?

A) Yelda Öğretmenin öğrencilerin öğrenmesini istediği kavramların bir açıklaması ile başlaması ve öğrencilerin besin üretiminin işik kaynaklı olduğunu duygulatan bir etkinlik yapımından dolayı, genel olarak bu iyi bir ders tanımlar.
B) Yelda Öğretmen öğrencilerin öğrenmesini istediği kavramların bir açıklamasını yaparak uygun bir şekilde sağlar. Ancak, özellikle çok fazla ders saatleri gerektirmesinden dolayı, etkinliğin gere ki olup olmadığı net değildir.
C) Yelda Öğretmenin yaklaşımı oldukça ön hazırlıklı ve sıkı kurallar içermektedir. Öğrencilerin bitkileri ve işikları nasıl düzenleyeceklerine kendi çabalarını verme opportünitesi, ne olacağını göremeleri ve yapracıkları besin üretimini karşılaştırmak için bir yol bulmaları daha iyi olabilir.
D) Öğrenciler ilk olarak besin üretiminin işik kaynaklı olduğunu gösteren bu bitki gözlemelerini yaprsa ve sonrasında da Yelda Öğretmen sürekli tamamen açıklasa, öğretim sıralaması daha iyi olabilir.

10. Gündüz Vakti Ay (Öğretilebilir Bir An)


Dersi nasıl işleyeceğinizi düşündügünüzde, öğrenciler smifa geri dönüştünde size Mehmet Öğretmen derse nasıl devam etmelidir?

A) Metin’in sorusunu öğrencilerine yönelttir, onlardan işk ve aydınlanma hakkında öğrencilerini kullanarak Ay’ı ve Güneş’i gösteren gökyüzü şemaları çizerek gözlemelerini açıklamalarını isterdik.
B) Sınıfın Ay’ın gündüz vakti görülememesi için bir nedenin bulunmadığını söylerdim. Bunun ardından öğrencilerden öğretmenleri uygulamalarını ve o gün Ay’ın Güneş tarafından nasıl aydınlatıldığını gösteren şemalar çizmelerini isterdik.
C) Sınıfın Ay’ın gündüz vakti görülememesi için bir sebep bulunmadığını söylerdim. Bunun ardından tahtaya Ay’ın o gün Güneş tarafından nasıl aydınlatıldığını gösteren bir gökyüzü şeması çizirdim.
D) Metin’in sorusunu öğrencilerine yönelttirdim. Fikirlerini ve olası açıklamalarını düşünmelerini ve bunları tartışarak sınıfın sunmalarını isterdik.

Zaman ayırdı bu anketi doldurduğunuz için teşekkür ederiz.
Appendix E

POSTT-TR Assessment Instrument Answer Key (Turkish)
<table>
<thead>
<tr>
<th>1 - Kuvvet ve Hareket Hakkında Ders</th>
<th>6 - Akarsu Masası</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Didactic Direct (DD)</td>
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<tr>
<td>B. Guided Inquiry (GI)</td>
<td>B. Open Inquiry (OI)</td>
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<td>C. Active Direct (AD)</td>
<td>C. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>D. Open Inquiry (OI)</td>
<td>D. Active Direct (AD)</td>
</tr>
<tr>
<td>2 - Ünite Genel Özeti</td>
<td>7 - Işığın Yansıması</td>
</tr>
<tr>
<td>A. Open Inquiry (OI)</td>
<td>A. Didactic Direct (DD)</td>
</tr>
<tr>
<td>B. Didactic Direct (DD)</td>
<td>B. Open Inquiry (OI)</td>
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<tr>
<td>D. Active Direct (AD)</td>
<td>D. Active Direct (AD)</td>
</tr>
<tr>
<td>3 - Güneş Saati</td>
<td>8 - Asit Ayracı</td>
</tr>
<tr>
<td>A. Active Direct (AD)</td>
<td>A. Didactic Direct (DD)</td>
</tr>
<tr>
<td>B. Open Inquiry (OI)</td>
<td>B. Active Direct (AD)</td>
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<td>C. Didactic Direct (DD)</td>
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<tr>
<td>D. Guided Inquiry (GI)</td>
<td>D. Open Inquiry (OI)</td>
</tr>
<tr>
<td>4 - Av ve Avcı</td>
<td>9 - Fotosentez</td>
</tr>
<tr>
<td>A. Didactic Direct (DD)</td>
<td>A. Active Direct (AD)</td>
</tr>
<tr>
<td>B. Active Direct (AD)</td>
<td>B. Didactic Direct (DD)</td>
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<td>C. Guided Inquiry (GI)</td>
<td>C. Open Inquiry (OI)</td>
</tr>
<tr>
<td>D. Open Inquiry (OI)</td>
<td>D. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>5 - Termometre ne yapar?</td>
<td>10 - Gündüz Vakti Ay</td>
</tr>
<tr>
<td>A. Didactic Direct (DD)</td>
<td>A. Guided Inquiry (GI)</td>
</tr>
<tr>
<td>B. Active Direct (AD)</td>
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Appendix F

Interview Protocol
Interview Protocol

1. Explain why you believe this is the most appropriate response to this teaching episode.

2. Why did you not choose the other teaching options?

3. Are there restrictions that may affect the way in which this topic is taught?

4. What external factors affect the way you teach in your classroom?
   a. I would like to know if any of these factors affect your teaching: Class size? Materials? Curriculum? Policy? School Administration? Content Knowledge?
   b. If there are any other factors that affect your teaching, please tell me and explain.
   c. How do these factors influence on your own pedagogical choices in your classroom?

5. How do you typically teach the same science topics or similar topics in your classroom?

6. What are the teaching approaches that you are comfortable using while teaching?

7. Has this workshop changed your ideas about using instructional practices in your classroom? If yes, can you explain how and why?
Appendix G

Data Summaries of Workshop Teachers
Data Summary of Metin

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Metin chose the open inquiry approach noting that it was important for students to ask their own questions, and that “student should explain their thoughts and summarize the topic with their own words.” (lines 100 – 101). He noted that this was how he studied a topic and that he thought his students should do likewise. He disapproved of the direct instruction approaches commenting that, while students will remember a topic that he explains, student learning will be better if “students explain [and] they use more sense organs.” (line 105). On the other hand, Metin rejected the guided instruction option because his sixth-grade students “could have difficulty relating the important central ideas of the unit with the original learning objectives.” (lines 106 – 107). The implication was that he needed to make the connection for the students. He also noted that his sixth-grade students were not capable of creating concept maps.

In contrast to item 2, for item 9, Metin chose the active direct response. He noted that for this response, “the teacher explains the concepts directly and then the students do a confirming activity about the concepts.” (lines 3 – 4). He then went on to indicate that is approach (“I felt so close to this teaching option”) (line 4). On the one hand, he did not think that the lesson was too prescriptive; and on the other hand, he did not think that the activity took too much time. However, when asked about open inquiry, he seemed favorable to that approach, and then said that “I misunderstood the question. So, I choose [open inquiry].” (line 14). Thus, it appears that his true response to item 2 is open inquiry. But having said that, he also declined to endorse guided inquiry because he “worried about how much time it takes without giving any directions/explanations.” (lines 17 – 18). When asked about his own teaching approach, he responded “I lecture the topic first and then give homework…,” (line 44) and noted that they did not have a science laboratory for laboratory work.

Regarding item 10, Metin again showed his preference for inquiry instruction. He again chose an inquiry response, but this time guided inquiry instead of open inquiry. He preferred the guided
inquiry option because the teacher had make diagrams, whereas that activity was not clear in the open inquiry option. He indicated that he thought it was a good idea to have students do brainstorming and to have “students tell their [own] answers,” (lines 52 – 53) where the teacher finally “gives the correct answer through discussing about student answers.” (line 53). He referred to this as “inquiry–based” learning and that students “comprehend the unit easier” (line 56) this way. He rejected the direct instructional methods because when using them “the teacher is killing the curiosity of students.” (line 70).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Metin indicated that classroom size, and the lack of materials, equipment, and textbooks can be a barrier to instruction. He also noted that “we do not have a science laboratory.” (line 24). He noted that student lack of prior knowledge can be a problem: if the students do not have relevant prior knowledge, “it is necessary to provide them with that prior knowledge when teaching the unit.” (lines 31 – 32). And, he noted “standardized test anxiety for 8th graders (line 27) … Therefore, we prefer to practice test items instead of performing an experiment or doing an activity.” (lines 37 – 38). When he has a large class, he also prefers “to lecture instead of [doing] an experiment… Otherwise, it is difficult to control or manage the classroom.

He also noted a difference between students who come from urban and rural areas. He said that “students who come from urban area learn better when they perform experiments.” (line 131). However, he said that rule area students are “more familiar with life science topics and can easily understand when I lecture.” (lines 132 – 133). He said the situation reverses with the topic such as motion: “this time the students who come from an urban area can understand the topic easier because they have seen metros, tramways so many times.” (lines 134 – 135).

Finally, Metin noted that textbooks are a problem. He said that they “generally follow the activities from the textbook, but [the textbook] is frequently changed” (lines 139 – 140) “almost every year.” (line 141).
RQ4: How does the teacher explain his actual classroom pedagogical practices?

When asked about his own teaching approach, Metin responded “I lecture the topic first and then give homework…,” (line 44) and noted that they did not have a science laboratory for laboratory work. He does do some activities. For example, he noted that “I have just experimented with the effect of water on photosynthesis (lines 41 – 42) … we tested plant growth by giving different amounts of water to similar plants.” (lines 42 – 43). He said that depending on the topic, he likes to use the 5E Instructional Model. As an example, he described his teaching of a unit on sound. He brings “thick and thin wire to the classroom.” (lines 62 – 63). The students then “observe the sound of both wires and discuss the reasons why these wires make different sounds. We begin the class this way to arouse the curiosity of the students.” (lines 63 – 64). He likes to have students write summaries that he then edits. He uses homework and he has students resolve questions from the textbook, “then we resolve the questions together in the classroom.” (lines 115 – 116).

Workshops

He has attended workshops about laboratory applications and has “learned new and interesting experiments.” (154 – 155).

Summary Statement

Consistent with his histogram (1 AD, 7 GI, 2OI), during the interview, Metin appeared to be a teacher who would like to be an inquiry teacher; he likes to use the 5E Instructional Model. He recognizes that “students are more successful when they produce, observe or perform something. Therefore, an experiment, project, or an observation plays very important roles in the learning process,” (lines 166 – 167) and it is important that knowledge be related to students’ daily lives. He clearly preferred inquiry options over the direct instruction options. However, he feels constrained by the lack of facilities for doing science activities. On the other hand, his comments suggest that he thinks that there is a critical role for direct instruction. For example, when asked about what he is comfortable using as a teaching method, he responded: “I feel more comfortable when I lecture.” (line 147). It appears that he primarily uses a direct instruction approach.
augmented by simple activities when possible. His use of activities is limited by the lack of materials, equipment, and facilities; but even with these things is likely that he would still employ direct instruction.
Data Summary of Semih

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Semih chose the guided inquiry response because this response had to do with the students’ daily lives, and Semih noted that “students should relate their learning outcomes and experiences with their daily life. It is the best way for students to present their main ideas.” (lines 92 – 93). He further explained that he prefers for students to find results: “students should play an active role in the experiment. Thus, they are able to gain experience.” (line 121). He rejected the direct instruction approaches because the outcomes are taught “directly by the teacher.” (line 98).

Similarly, regarding item 9, Semih chose the guided inquiry response “because students are able to do the plant observation first. Then, the teacher explains the process with supportive information.” (lines 3 – 4). However, during the interview Semih realized he had misunderstood one of the responses and changed to the open inquiry response. He clearly prefers inquiry-type instruction: “students should observe. Then, the teacher should explain supportive information and summarize the topic.” (lines 8 – 9). He did not like the direct instruction approaches because “the teacher explains the concept first.” (line 6).

As with item 9, regarding item 10, Semih chose the open inquiry approach. He explains that the question the student asked was “a good question for thinking” (line 63) and that the teacher should follow up with “brainstorming to find the answer among students.” (line 64). He preferred the open inquiry approach over the guided inquiry approach because the former “provides more thinking and brainstorming opportunity for the students.” (lines 68 – 69). He implied that the direct instruction approaches do not provide students with opportunities to think or to brainstorm.
**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

However, Semih indicated that he does not use inquiry instruction as much as he would like to, but rather uses more direct instruction: “I try to benefit from inquiry instruction. However, external factors effect on it.” (line 71) “I can’t teach similarly [referring to inquiry] because of student based and environmental factors.” (lines 55 – 56). Due to the “low readiness level of the students and lack of prior knowledge about a topic,” (lines 28) he says that he “can’t efficiently benefit from the [inquiry] activities during the class time.” (line 29). He says that direct instruction is necessary because of barriers such as inadequate laboratories, lack of materials, underprepared students, and insufficient time “for covering the whole curriculum.” (line 73).

**RQ4: How does the teacher explain his actual classroom pedagogical practices?**

When asked about his own teaching, and about what instructional approaches he is comfortable with, he describe something like a Socratic question and answer approach: “I verbally examine general knowledge of the students through question and answer teaching method. I try to lead them to find the purpose of the unit (lines 113 – 114) …” and relate “the topic with daily life.” (lines 114 – 115). Semih says he wants students to be active but the instruction he describes is more direct instruction than inquiry instruction: “I usually teach the lesson through websites/videos and require [students] taking notes.” (lines 58 – 59).

**Workshop**

On the other hand, he has attended instructional workshops, and that he is now less direct instruction, and tries to use more inquiry style experiments.

**Summary Statement**

Semih appears to be a teacher who in the past was very direct instruction, using direct instruction methods, but is now attempting to change his instructional efforts so that he is more inquiry-centered, which is reflected in his histogram (5GI; 5OI). He does not, however, appear to have a
clear understanding as to why inquiry instruction, inquiry science teaching be better. Semih does not provide an explanation for why an inquiry approach is better than direct instruction; though he does suggest that students might be more interested if they can connect science with their daily lives.
Data Summary of Zerrin

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Zerrin chose the active direct response, explaining that while “it is not good to restate the three learning objectives by the teacher instead of students… I thought that students were not able to catch the main ideas concerning when looking at the other options.” (lines 85-87). That being the case, she felt the teacher should restate the learning objectives. She was concerned that students might mess the objectives of the lesson in which case the “teacher has to lead them to gain the required learning objectives.” (line 92). She did not like the open inquiry option because the teacher’s wrap up depended “on the students own ideas of what is important.” (line 96). It appeared to be important that the teacher be responsible for clearly stating the learning objectives for the students.

Regarding item 9, Zerrin at first said that she prefers the open inquiry option “because the students decide how to set up plants and lights.” (line 3). Moments later, she said “wait a minute” (line 9) and that she changed her choice to the active direct response. However, she seems to have misunderstood some of the responses because her explanations sounds like her preference is either active direct or guided inquiry. For example, she said that she did not like the direct instruction options “because the teacher explains the process fully. The students should do it themselves.” (line 6). Whereas she thought that it was good that “the teacher begins with some explanation about the concepts,” (lines 7 – 8) she did not like the direct instruction options because after some direct instruction “students should more actively attend the activity.” (line 8). But with respect to the lesson on photosynthesis, she spoke of an activity being confirmatory: the teacher’s explanations should be followed by an “activity for students to confirm that chlorophyll is light induced.” (lines 13 – 14).

Regarding item 10, Zerrin interestingly respondent that she preferred both the open inquiry and direct didactic options. She explains saying that she “would require [the students] to come up with their ideas and possible explanations, followed by discussion. Then they would report these
to the class.” (lines 48 – 50). She went on to explain that she would subsequently use the direct didactic approach where she would explain the concept to the students. She said, “I don’t directly explain the concept. I like to have students think about the concept and the lesson.” (lines 58 – 59). She elaborated saying, “first, the student should think about the question and share their ideas with classmates. Then the teacher should explain…” (lines 61 – 62) the concept.

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Zerrin indicated that she worked in “good school” (line 39) where she has sufficient materials and that her “students are interested in science topics and they have high levels of readiness.” (lines 40 – 41). However, she also said that sometimes it can be difficult to find materials, such as chemicals.

RQ4: How does the teacher explain her actual classroom pedagogical practices?

When asked about her own teaching, Zerrin explained that she prefers “to explain the concepts first and then students do an activity.” (line 18). With respect to the photosynthesis lesson, she also said that she would subsequently “summarize the activity and emphasized the importance of the light to photosynthesis after doing the activity.” (lines 22 – 23). She would then “repeat the learning objectives at the end of the lesson.” (lines 23 – 24). About another lesson, she said that she would “write the learning objectives on the board at the beginning of the lesson” (lines 120 – 121) and then have the students do an activity. “Last, I summarize the unit by answering the questions and concerns.” (lines 121 – 122). Nevertheless, she said that she did not “support direct instruction,” (line 103) though she also talked about using a smart board and videos especially when an activity was not possible. She said that she liked to use “discussion and question and answer teaching methods.” (line 125). However, she also says that she tries to guide students towards the learning objectives, and “if any of the students go off subject” (line 126) she corrects them. She says that she prefers for her students to “perform the experiment themselves” (line 130) with her only guiding.
Workshops

Zerrin only spoke of the current workshop where she is learning about more activities that she can use in the classroom.

Summary Statement

It is difficult to know what to think about Zerrin’s approach to teaching. For example, in her discussion of item 10, she wanted to choose both open inquiry and didactic direct instruction. What she then described appears to be a student, open inquiry lesson that she concludes by presenting an explanation of concepts unconnected with the students’ activity. She says that she does not support using direct instruction and yet the instruction she describes using has a significant teacher-centered component. She does not offer much in the way of reasons for her pedagogical choices other than saying that she likes to have classroom discussions because her students are talkative. Zerrin appears to be something between an active direct and a guided inquiry oriented teacher, which is consistent with her histogram (1DD, 1DA, 6GI, 2OI).
Summary of Ayten

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Ayten chose the direct active response. She explained that “the concept of Earth science…is intangible concepts for students. Therefore, I prefer explaining the concepts…at the beginning part of the lesson” (lines 84 – 86). On the other hand, she did not like the didactic direct option, “because the students do not have any role during the learning process. They are passive. The teacher restates the learning objectives and relates them with specific concepts himself” (lines 91 – 93). Neither did she like the two inquiry options. She did not think that for this particular item the open inquiry approach lead to meaningful learning; and she was concerned that the guided inquiry option included “no teacher explanation.” She reasoned that a “teacher explanation is needed because the students could make a mistake or misunderstand something about the concepts” (lines 94 – 95).

In contrast to her response to item 2, regarding item 9, Ayten chose the guided inquiry response explaining that “according to my teaching perspective, the teacher should begin the lesson with an experiment or visuals to arouse students’ interest. Then the teacher is able to provide meaningful learning students by explaining the process more fully” (lines 3 – 4). She did not like the direct instruction responses because she believes that “doing an activity is necessary for the students to experience and relate the concept with their daily life” (lines 8 – 9). She also commented that “students get bored with the teacher begins the lesson by explaining the concepts” (lines 10 – 11). On the other hand, she rejected the open inquiry response because she believes “that the teacher should be a guide during the learning process” (line 12). She explained that she wants students to have “more freedom in the classroom. However, teacher guidance is necessary” (lines 13 – 14). She thinks that “the teacher should arouse students’ interest with the activity and then guide them by explaining the process more fully” (lines 18 – 19).

As with item 9, regarding item 10, Ayten chose the guided inquiry response. She liked it that the teacher asked the rest of the class about the one students question, because “the students actively
attend the learning process and explain their ideas and observations” (lines 45 – 46). She did not like the direct instruction approaches because “the teacher answered the question himself. He directly gives the information” (lines 51 – 52). Instead, first “the teacher should arouse [student] interest by asking the question” of the students and having them respond from “their thoughts or observations” (lines 49 – 51). On the other hand, she also rejected the open inquiry response because it did not involve the teacher wrapping up the lesson: “the teacher should conclude the topic. Otherwise, some students may not be able to relate their ideas with specific concepts” (lines 55 – 56).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Ayten indicated that the lack of time can be a barrier for doing activities in the classroom. She also noted that sometimes students do not bring needed materials from home. She noted that the lack of materials can be a barrier to instruction. In addition, she noted that standardized testing affects her teaching: “after taking the exam, the students are absent from school or they have low motivation” (line 73 – 74). She said that she would “like to organize outdoor activities or science tours, but the school administrator doesn’t get permission because of a limited budget” (lines 106 – 107).

**RQ4: How does the teacher explain her actual classroom pedagogical practices?**

When speaking about her own teaching, Ayten said that she likes to do experiments. She uses models and visuals such as smart boards, videos and simulations. She also likes to use concept maps explaining that they help the students to see the “big picture concerning the lesson” (lines 86 – 87). One of the things that Ayten said about her own teaching is that she does not like to tell students “something is wrong or incomplete” because she does not want to discourage them. She says, “I prefer eliminating that misunderstandings or mistakes without hurting my students” (lines 57 – 59). Ayten is also a teacher who recognizes the difference between lower grade students and upper grades students. She says that her sixth-graders “like playing games because of their age” (line 119). Older students are able to do activities and “to share their ideas and
discuss with their classmates” (lines 121 – 122). With her older students, she does not always need to “explain the concepts first” (lines 122 – 123).

**Workshops**

This was Ayten’s first workshop. She said that she was learning a variety of activities that she could use in the classroom without taking up too much time. Time is important because of the standardized tests.

**Summary Statement**

Ayten appears to be a teacher who balances both direct and inquiry styles instruction, which is consistent with her histogram (3AD, 5GI, 2OI). She says that she likes to begin a “lesson with an experiment or visuals to arouse students’ interest. Then the teacher is able to provide meaningful learning students by explaining the process more fully” (lines 3 – 4). On the other hand, she rejected one open inquiry response because she believes “that the teacher should be a guide during the learning process” (line 12). She explained that she wants students to have “more freedom in the classroom. However, teacher guidance is necessary” (lines 13 – 14). Without teacher guidance, the students may have misconceptions.
Summary of Sibel

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Sibel chose the active direct response “because the main purpose is to wrap up the unit and concept mapping is a very helpful method for this” (lines 86 – 87). She indicated that with the concept maps, “students try to relate [the] learning objectives with various concepts was quote lines 87 – 88). She seemed to think that concept maps were more appropriate for eighth-graders than for sixth-graders. She did not like the open inquiry approach because “the students could have difficulty relating their ideas with the main things… they have already completed in the unit” (lines 91 – 92). On the other hand, Sibel did not like the direct didactic approach “because the teacher explains the learning objectives and relates them with the concepts” while “the students are passive” (lines 94 – 95). She also did not like the guided inquiry approach because it would be difficult for sixth-graders “to identify important central ideas” explaining that these are “intangible for this grade. The teacher has to intervene with the students and guide them more” (lines 96 – 98). She indicated that eighth-graders are more capable. She summarized saying that if she were to teach the lesson she would use ideas from the open inquiry approach and then wrap up with the active direct approach.

Similarly, regarding item 9, Sibel chose the active direct response “because the teacher begins an explanation of the concepts to arouse the students’ interest. Then, the students do an activity to confirm…” the explanation (lines 3 – 4). Thus, the students are better able to learn the concepts. Although she chose the active direct response, she said that she would actually prefer the guided inquiry response because she wants “to give the control to the students and they observed the relationship between chlorophyll on the sun” (lines 10 – 12). However, she did not select this option saying, “unfortunately this method takes too much time and there is the standardized test…” to consider. She explained, “I would prefer this teaching option if we didn’t have a time limitation problem and standardized test anxiety” (lines 10 – 11). Sybil did not like the didactic direct approach however because she considered that the activity was important. She also did not like the open inquiry approach because she did not think that the students would be “able to set
up plants and lights properly” for the activity, but “need to follow the teacher’s directions to set up the activity” (lines 8 – 10).

In contrast to item 9, regarding item 10, Sibel chose the open inquiry response saying that it was “very similar to [her] teaching style” (line 45). When a student in her class asks a question that causes the students to think, she says “I guide and encourage them to share their ideas or possible explanations. I don’t say anything about their answers being true or false” (lines 45 – 47). She goes on to say that she would have them perform an experiment if time permitted. At the end, however, she gives “them the correct answer and concludes the lesson” (line 49). Although she said she would not choose the guided inquiry approach, her explanation of how she would teach this lesson sounded more like guided inquiry than open inquiry. On the other hand, she clearly rejected the direct instruction approaches “because the teacher answers the question and goes on with the class” (lines 54 – 55). She further explained that “the students are passive during the learning process” (line 57). She thought that the direct instruction approaches suggested that the teacher did not think the student’s question was important. She also was concerned that, while in the direct instruction approaches the teacher provided an answer, “the teacher doesn’t mention the reason…,” going on to explain that “it is very important [to give a reason] because there is always a cause and effect relationship in science” (lines 58 – 59).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Sibel was very clear that the need to prepare eighth grade students for the standardized test had an impact on her instruction. Her class spends “additional time solving test questions” (lines 27 – 28). She noted that sometimes she has to do fewer activities with eighth-graders because of the “high expectations of parents” for their children success on standardized tests. Those parents, she explained, “require [her] to do less activity or experiments and practice more test questions” (lines 119 – 121).
Sibel also noted that even at the lower grades time can be a factor given that “activities take a
long time because of fifth and sixth grade students [weaker] motor skills” (line 72). Nevertheless,
she said that time “is not a big problem because the curriculum provides more flexibility to do
activities with sixth-graders” and “there is no standardized test anxiety” (lines 76 – 79). On the
other hand, she said that students can be “irresponsible” in that they don’t bring materials to the
classroom (“some students do not bring the materials”) (lines 113 – 115). However, she also
noted that some students have “economic problems because they are coming from low income
families. Some of them have family related problems, for example divorced parents” (lines 115 –
118).

Overall, she seemed to have a positive view of her classroom. She noted that “class-size is a
positive factor… because there are [only] approximately 20 students” and that she has access to a
“science laboratory and adequate materials for experiments” (lines 108 – 110). She also has a
Smart Board. She noted that the “revise curriculum will be more helpful for [her] because some
units have been shifted from eighth grade to seventh grade” (lines 111 – 112) where there is
more time and no test anxiety.

**RQ4: How does the teacher explain her actual classroom pedagogical practices?**

When asked about her own teaching, Sibel indicated that it was important to relate science topics
to “daily life” in order for the learning to be meaningful (lines 16 – 17). She also assigns
homework and group work. Students working in groups report their findings to the class. She
thinks that lab activities are motivational for students and that use of visuals helps student
learning. When students don’t bring needed materials to class she tries to work around this
problem by having students work in groups “with the students who have the materials” (lines
124 – 125). She says that she uses “inquiry-based teaching and constructivist learning models
because these are directly related with my master’s thesis” though she does not explain her thesis
(lines 142 – 143). She says that she uses experiments and problem-based learning, analogies,
animations, and concept maps.
**Workshops**

Although Sibel has been teaching for a number of years, this was her first workshop. She indicated that what she is learning from the workshop is how to do activities in less time. She commented that before the workshop she “had to worry about time limitations because of the [need for] standardized test preparation” (lines 155 – 157). Now she says that she believes that she can “effectively teach and use various activities or experiments in a short time” (lines 157 – 158).

**Summary Statement**

Sibel appears to be an inquiry – oriented teacher, which is consistent with her histogram (3AD, 3GI, 4OI), though her idea of inquiry appears to include significant elements of direct instruction. Even when she chose an open inquiry approach, her additional comments on how she would in the lesson indicate that she would and with direct instruction. Her view of open inquiry would seem to be something between active direct and guided inquiry approaches rather than true open inquiry. Indeed, she suggested something like this when summarizing her comments on item 2, she would use ideas from the open inquiry approach and then wrap up with the active direct approach. Other than mentioning her master’s thesis as a reason for her approach to teaching, the only explicit reason she gives for an inquiry approach is that doing activities is motivating for students. Sibel is a veteran teacher who expresses confidence in her ability to teach.
Summary of Müge

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Müge the open inquiry response “because the teacher asked the students what the main things are that they have learned in the unit and has them list these as the unit wrap-up” (lines 91 – 92). She says that she follows a “similar way in the classroom through the textbook” (lines 92 – 93). She indicated that at the end of the unit in the textbook, there is an opportunity for the review of learning objectives. She explains that she follows the “learning objectives from the textbook” and then explains “the concepts by relating them with examples from daily life” (lines 96 – 97). However, she did not like the didactic direct or guided inquiry options because she thought that these involved restating or repeating the learning objectives, explaining “I do not require my students to identify important central ideas of the unit since we have completed the unit. We must’ve done it, so don’t need to repeat it” (lines 101 – 102). Müge makes a distinction between restating the learning objectives at the end of the unit and concluding the unit. “We review the summary part of the unit from the textbook” and “I solve problems” (line 114). She concludes a unit by asking “thinking questions [of the students]” and solving problems in preparation for the standardized exam (lines 108 – 109). She explained saying, “I do all these because we have an exam-based education system and I try to prepare them for this. If my students have any unclear thing in their mind, I try to explain it through visuals” (lines 110 – 111).

Similarly, regarding item 9, Müge chose the open inquiry response but seems to have misunderstood the responses. She chose this response because “the activity needs to be pre-organized and prescriptive,” but the open inquiry response is the opposite of this description. She actually said that the direct instruction responses were “okay because of time limitations” (lines 6 – 7). Müge said that she would “clarify the purpose of the activity then the students would reach the knowledge” (lines 15 – 16). On the other hand she indicated that she didn’t think that students should through an activity simply “confirm the concepts that the teacher wants them to learn” but that “the student should do the activity and share their observations” (lines 8 – 9). She
said that activities are needed but that they take a long time. Her discussion of item 9 suggests that her preferred approach is more likely to be active direct than open inquiry.

Regarding item 10, Müge chose the active direct option saying that “it is similar to [her] teaching in the classroom” (line 45). She indicated that she would first give the students a short explanation and then follow with an activity such as having students create a model or diagrams. She said that it was important that the “students rather than the teacher” do these things because “it is more meaningful for [the students]” (lines 49 – 50). She did not like the didactic direct option “because the teacher answers the [student’s] question… the students do not do anything about thinking and learning about the topic. They are all passive participants during the observation and explanation” (lines 55 – 58). She also did not like the open inquiry approach explaining that “unfortunately, following this way takes too much time” (line 60). She also added that some of her “students lack motivation and interest” and “these students don’t attend the discussion” (lines 61 – 62). She said that these students only “learn something when we conclude our findings” (line 62 – 63).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Müge noted that there are immigrant students “from different cities” that lack motivation; “many of them do not bring their books to the classroom” (lines 20 – 22). This has an impact on her instruction. She also indicated that the “lack of materials directly affects [her] teaching… [She is] not able to find main materials for an activity or experiment” (lines 25 – 26). She also said that they lack equipment and for these reasons they “are not able to benefit from observations or experiments” (lines 26 – 27). She further noted that time as a limitation: “I would like my students to perform an experiment or do an observation themselves and discuss about their ideas. Unfortunately, limited time in the classroom obligates me to lead my students and explain the important point about the unit” (lines 30 – 33). She also noted that they “do not have a laboratory and adequate materials for doing experiments” (line 137).
RQ4: How does the teacher explain her actual classroom pedagogical practices?

When asked about her own teaching, Müge said that because of various factors, such as lack of student interest (“irresponsible students do not bring their textbooks to the classroom”) and the weather (“my class is too hot during the spring and summer”), she uses lectures and uses visuals: “I generally use lecturing, solving problem or question and answer teaching method” (lines 40 – 41, 118 – 121). “I lecture verbally because group discussion or similar methods take too much time. Especially for teaching less interested and motivated students” (lines 76 – 77). “I prefer my students to read the unit from the textbook at the beginning of the class” (line 132). She also assigns the students “research homework” and she has them prepare posters and models (lines 41 – 42).

Workshops

In the past, Müge has attended in-service programs about using drama in the classroom and about classroom management. She says that she has “improved [her] classroom management skills” and that she can now “organize activities more effectively and spend less time to do them” (lines 145 – 146). She says that the current workshop has “changed [her] perspective concerning [her] teaching] and that she will now “focus more on inquiry-based teaching” and “ask more why–questions to [her] students” (lines 149 – 150). She says that she now intends to “begin the class with thinking questions about the concepts or playing small games.” She says, “I have also recognize that with just doing small activities, the students are more interested in the topic” (lines 151 – 152).

Summary Statement

Müge appears to be a direct instruction–oriented teacher. Her reasons are primarily about the factors in her classroom such as time limitations and student lack of interest. She is very concerned about preparing her students for the standardized exam. She says that to “benefit from laboratory activities” they would need more class time for completing the unit (line 124). However, she also says that the current workshop has changed her perspective on instruction and that she intends to adopt a more inquiry orientation. Because of what she is learning at the
workshop, she may be a teacher in transition which would account for her more inquiry-oriented histogram (2AD, 4GI, OI4).
Summary of Yurdanur

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Yurdanur chose guided inquiry “because it is student-based teaching and they think themselves.” (line 65). She says that students “should lead the process and find the solution of their problems.” (lines 67 – 68). She also said that she liked the open inquiry approach but that it was inappropriate for the “new education policy.” (line 71).

Similarly, regarding item 9, Yurdanur says that his motto is “learning by doing in living.” (line 3). She chose open inquiry because he wants students to choose their own way of doing things and to learn from their own findings. Yurdanur did not like the more direct instruction approaches because she wants students to be involved with the activities.

Regarding item 10, Yurdanur again preferred a more inquiry instructional approach, guided inquiry where the students are more active. She did not like the direct instruction approach is because “there is no inquiry, no investigation,” (line 37) or, the “teacher does everything.” (line 38).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Yurdanur indicated that the lack of materials can be a barrier to lab work as well as class size, students’ prior knowledge and academic proficiency. She also indicated that grade level influences teaching approach. She indicates that one barrier is the low income of some parents. Some parents cannot afford to provide materials. Yurdanur indicated that there are time limitations and that sometimes students are anxious because they have to get ready for standardized tests.
RQ4: How does the teacher explain her actual classroom pedagogical practices?

When asked about her own teaching, Yurdanur described inquiry instructional approaches. She indicated that she provides the equipment and the experimental set up but then she has the students to the activities. Yurdanur guides a discussion once they have their results. She likes to use small group activities where the students conduct experiments. She tries to help “low-level” (lines 88 – 89) students. Yurdanur also likes to use dramatizations and modeling, and she likes to give students opportunities to improvise. She says that she likes to construct lessons where the students have more freedom. Yurdanur said that he tried to make science fun and interesting. She indicates that she tries to be inquiry instruction.

Workshop

It does not seem that workshops have influenced her teaching approach as the workshops she has attended have been about content knowledge.

Summary Statement

Yurdanur appears to be a teacher who practices inquiry instruction, inquiry style instruction, which is consistent with her histogram (8GI, 2OI). While there may be some barriers to inquiry instruction, it does not appear that the barriers keep her from using inquiry instruction approaches. Yurdanur appears to prefer inquiry style instruction because it is inquiry instruction but she does not offer reasons beyond that.
Summary of Esin

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Esin chose the guided inquiry response because this seems to be similar to what she does in her classroom. She tells her students what the learning objectives are and then she asked her students “thinking questions concerning the learning objectives.” (lines 79 – 80). Esin explains that she is a “behaviorist” (line 82) and attaches much importance to learning outcomes.

Similarly, regarding item 9, Esin preferred open inquiry stating that “students should decide how to set up the activity.” (lines 3 – 4). She rejected the more teacher direct approaches because the teacher was providing too much information. On the other hand, Esin did not like the guided inquiry approach because she felt that “students should reach the result in summarize themselves.”

Regarding item 10, Esin preferred the active direct approach and indicated that the active direct response for item 10 was similar to what she did in the classroom (“it is the same as what I do sometimes”) (line 34). She did not like the opening question in the vignette saying that she prefers to explain the concept herself (“I prefer to explain myself”) (line 44).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Esin’s school is in a rural area and she indicated that a lack of materials can be a barrier to the type of instruction that can be used. She also noted that inquiry lessons require more class time and she noted that “students have different levels of interest” (line 22) towards a lesson and that less motivated students require more direct instruction (“I provide more explanations for lower-level motivated students.”) (line 27).
Esin also noted that exam anxiety “especially at the eighth grade” (line 108) is a factor in how she teaches, and that due to exams sometimes “students do not have enough time to think and discuss about the topic.” (line 86). “There is not enough time for doing activities.” (line 108). Sometimes she has trouble finding materials and “I have to give up and cancel the activity.” (lines 112 – 113).

**RQ4: How does the teacher explain her actual classroom pedagogical practices?**

When asked about her own teaching, Esin indicated that she likes to have students do an activity and then help them to think about the activity by guiding them with questions. The students then report their results. But she does use some direct instruction methods, for example, when she teaches about the moon (“I also draw schema when I lecture about the phases of the moon”) (line 42). Her approach is active direct in that she uses videos, visuals, and teacher explanations following with having the students draw their own schemas (“I explain a little bit and then require them to explain or draw their schemas on the whiteboard”) (lines 46 – 47). As noted for item 2, Esin likes to clearly state learning objectives for the students and then at the end of the lesson she requires students “to relate their knowledge” (line 95) learning objectives concept maps.

**Workshop**

She indicated that the workshop she was now attending (her first) has caused her to think about using more activities.

**Summary Statement**

Consistent with her histogram (1DD, 4AD, 2GI, 3OI), Esin appears to be a teacher who combines both direct instruction and inquiry instructional approaches. She says that she feels “inadequate” (line 135) and that she needs to find “different activities.” (line 136). She says that she wishes to encourage student “curiosity” (line 135) (“I would like to address all sense organs of the students”) (line 131) and to use more “inquiry-based teaching techniques.” (line 135).
However, Esin also makes it clear that she thinks that stating learning objectives for the students is very important; and she is aware that this is a behaviorist technique.
Summary of Ferit

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Ferit chose the open inquiry approach “because the teacher asks about the students’ ideas” (line 152). He explained that he wanted to know what his students found important and interesting, which is information that could inform his instruction. He did not like the direct instruction approaches because they are “teacher based” with the teacher restating “the learning objectives and [relating] them with specific concepts.” The teacher “leaves the students and they just follow what the teacher presents” (lines 158 – 160). On the other hand, he did not like the guided inquiry option saying that it was important for the teacher to “conclude [the lesson] relating these important ideas with the original learning objectives. Otherwise the students could digress” (lines 162 – 165).

Regarding item 9, Ferit chose the guided inquiry response saying, “I should give my students more freedom. Thus, they are able to explore and look at the activity from different perspectives” (lines 3 – 4). He rejected the direct instruction approaches “because this teaching option is teacher based” whereas he wanted his “students to learn through live and learn, exploration, and discovery methods” (lines 7 – 9). He further commented that direct instruction “does not encourage students to do activities” (lines 9 – 10). He said that “students should do observations and record their findings. Then they should make inferences about their findings” (lines 18 – 19). Nevertheless, he also indicated that the teacher can “give a short explanation to the students” (lines 21 – 22). Moreover, he said that he would “begin the lesson with giving some examples by photosynthesis plays an important role in human life” then he would “continue with thinking questions” (lines 29 – 30). Subsequently he would have them do the activity: the students “would make inferences about their observations and relate with their prior knowledge… they would conclude their observations and presented in front of the classroom” (lines 34 – 36).

Regarding item 10, Ferit chose the open inquiry response because he approved of the teacher asking the student’s question to the rest of the class. He considered important for the teacher to
give the students “time to present their ideas and possible explanations,” and they should be able to “discuss their observations,” and then at the end the teacher concludes. This way, the students “actively attend the learning process” which is what he proposes “to do in the classroom” (lines 84 – 88). He did not like the guided inquiry approach because he found it too teacher oriented (“[the students] learned [the concept] in the classroom from the teacher,” lines 92 – 94). He also did not like the direct instruction responses “because the teacher answers the question;” rather, “the teacher should have asked [the students] thinking questions.” Otherwise, “the students do not learn and live the topic. They are passive during the learning process” (lines 94 – 98).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Ferit believes that the Turkish curriculum inhibits a constructivist approach to the teaching of science because in the curriculum “there is no helpful information… regarding how teachers can help students relate specific science concepts with their daily lives” (lines 47 – 49). He is also concerned that the curriculum does not appropriately coordinate math and science. He also indicated that the lack of materials can be a barrier two instruction. He noted that he does not have a microscope and that the school does not “provide necessary equipment or materials because of limited financial support” (lines 55 – 56). He also indicated that there are time limitations and sometimes difficulties with student discipline. Crowded class conditions can keep him from spending “enough time for each student” (lines 185 – 186).

**RQ4: How does the teacher explain his actual classroom pedagogical practices?**

In spite of the limitations he faces, Ferit says that he does not allow these limitations to influence his pedagogical choices. He prepares his lessons ahead of time and finds alternative materials. He makes the needed effort so that she is “students always attend the learning process actively” (line 63 – 65). When asked about his own teaching, he said that he begins a lesson asking a “thinking question” for discussion, then he introduces the concept. At the start of the lesson he says that he gives “students 10 minutes for thinking and explaining their ideas” then he requires “them to write their explanations on the whiteboard… and we discuss about their explanations”
Workshops

In addition to the current workshop, Ferit has attended project-based science workshops where he has learned “different methods concerning how students explore specific concepts.” These workshops have encouraged him “to apply more educational activities in the classroom and” have motivated him to be a better teacher (lines 212 – 260). The current workshop has helped him learn to do activities that do not require much time.

Summary Statement

Ferit appears to be an inquiry–oriented teacher, which is consistent with his histogram (1AD, 5GI, 4OI); however, his discussion of teaching suggests that his view of inquiry falls somewhere between active direct instruction and guided inquiry. He says that he tries to follow a constructivist approach and that “teachers should integrate daily life situations into the curriculum and required learning objectives” (lines 45 – 47). He describes his approach as one
where a lesson opens with thinking questions followed by an activity with him concluding the lesson. He clearly stresses that students need to do activities and that there is a role for direct instruction. Other than mentioning the importance of getting students actively involved with the lesson, he does not provide reasons for his pedagogical choices.
Summary of Hüseyin

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Hüseyin initially chose the active direct response but then changed his mind to open inquiry. This item has to do with wrapping up a unit and he explained that because the students had already completed the unit he as the teacher would not “need to restate the learning objectives. At this point it is more important to determine [students’] own ideas of what is important or interesting in the unit.” (lines 81 – 83). “I also would like them to explain what they have learned with their own sentences.” (line 85). His role as the teacher would be to “identify and fix incomplete or misunderstood parts of the unit.” (line 84). However, he thought it would be difficult for students “to relate important central ideas of the unit with the original learning objectives” (lines 89 – 90) because their thinking might have important omissions. Instead he suggested that he would “relate the main ideas with the learning objectives” (line 94) for the students and that “they could take notes” (line 95) while he gave “them supported information.” (line 95).

In contrast to his choice for item 2, regarding item 9, Hüseyin chose the active direct response “because the teacher should explain the main concepts to form [the students] regarding the topic” (lines 3 – 4) followed by an activity in which the students are involved. He was also open to the guided inquiry approach, but rejected the open inquiry approach disagreeing that “the students decide how to set up plants and light” (lines 8 – 9) because “they could wrongly set up [the activity] … could lose much time when doing the activity.” (lines 9 – 10). He was clear that the “teacher should mention about the concepts for the students who haven’t seen them before.” (lines 11 – 12). He supported having the students conduct the activity, but “the teacher should give them directions how to set up the activity.” (line 19).

Regarding item 10, Hüseyin chose the guided inquiry response because he approved of how the teacher got the students “to use what they have learned to explain” (lines 42 – 43) the student’s observation. In this way, he explained, “the students repeat their knowledge and brainstorming
about the question.” (lines 43 – 44). He did not like the direct instruction options “because the teacher answered the question” (line 46) which could cause “the students to lose their interest in the topic.” (lines 46 – 47). Neither did he like the open inquiry response that involve students reporting their own ideas and possible explanations. Rather he thought it “better answering the question after [the student] shared his observation.” (lines 48 – 49). In other words, he wanted the students to provide an explanation right away rather than considering the matter further or doing further investigations. He explained that he thought the students would “have enough background knowledge” (lines 51 -52) to explain the students’ observation. He would thus have the students discuss the observation in groups and report back to the class.

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Hüseyin indicated that the lack of time can be a barrier to some teaching practices in light of the standardized testing required of eighth graders. He also indicated that some “parents are less interested in their children education. Therefore, the students do not do their homework and come to class with low motivation/inappropriate prior knowledge.” (lines 29 – 30). He further explained “even though I prefer my students share their ideas and discuss… with their classmates, I sometimes need to lead them and give them more explanations or definitions.” (lines 110 – 112).

He also noted that there is a lack of materials in the school laboratory and that the school laboratory is actually far away from his classroom. These make it difficult to use the laboratory. “I have avoided… using the science laboratory because going and coming back from the laboratory loses extra time.” He further explained that he was faced with “classroom/laboratory management problems.” (lines 68 – 70).
RQ4: How does the teacher explain his actual classroom pedagogical practices?

When asked about his own teaching, Hüseyin said that he does not necessarily “give [the students] homework because they don’t do it and nobody controls them.” (lines 33 – 34). He further explains, “I provide the concept of myself at the beginning of class. Then my students perform the experiment or to the activity.” (lines 34 -35). When he does have students do an activity, he believes that he “should give [the students] directions how to set up the activity.” (line 19). He uses simulations and a smart board and he has the students “practice by solving problems.” (lines 38 – 39).

Workshops

He has attended workshops that he says have helped him learn how to better organize science experiments. About the current workshop, he says that “it didn’t significantly change my ideas.” (lines 124 -125).

Summary Statement

Hüseyin appears to be a direct instruction–oriented teacher, which is inconsistent with his histogram (2AD, 4GI, 4OI). When he explained his choice of inquiry options, he clearly described inquiry within a direct instructional environment. For example, in explaining his open inquiry choice for item 2, he also said that the teacher’s role would be to “identify and fix incomplete or misunderstood parts of the unit.” (line 84). Regarding item 9, he rejected the open inquiry approach disagreeing that “the students decide how to set up plants and light” (lines 8 – 9) because “they could wrongly set up [the activity] … could lose much time when doing the activity.” (lines 9 – 10). His view of inquiry seems to be more that of confirmatory lab activities that the students do subsequent to his explaining of concepts. He is also teacher who seems to feel significantly constrained by external factors.

Hüseyin did not provide many reasons for his pedagogical choices other than ones. He indicated that there were laboratory activities he could not do because of inadequate facilities, lack of
parental support, or lack of student readiness. The only positive reason he gave was about student interest. He indicated that students might lose interest if they were not sufficiently involved in a lesson, and he realized that “experiments are very helpful to arouse students’ interests especially at the beginning of the semester.” (lines 130 – 131).
Summary of Pelin

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Pelin chose the active direct response. She indicated that it was important that the teacher “restates three learning objectives” (line 84) and that students “prepare concept maps based on these learning objectives.” (line 85). She noted that with concept maps “students can see the big picture about the unit on one page.” (lines 86 – 87). Pelin did not like the open inquiry approach in part because the wrap-up was done by the students read the teacher. She seemed to think that the open inquiry approach lacked direction: “this method is insufficient because students could have different interests and ideas about the unit. They could think different parts of the unit as important.” (lines 90 – 92). Pelin also did not like the guided inquiry approach because the teacher did not do a wrap-up of the lesson. But neither did she like the didactic approach because as described the teacher did not do the wrap-up.

Similarly, regarding item 9, Pelin chose the active direct response because, she reported, “students learn through experience.” (lines 4 – 5). In her opinion, the activity was not too time-consuming or too prescriptive. On the other hand, Pelin rejected the guided inquiry option because she felt that the teacher needed to have a larger role in the lesson than suggested by the guided inquiry approach. She noted that she felt the teacher short “summarize topic at the end of the lesson.” (line 15).

Regarding item 10, as with item 2 and 9, Pelin chose the active direct response. She noted that students come to class with some knowledge about the moon and that the teacher’s job is to help students “construct new knowledge” (line 45) related to “existing knowledge.” (line 45). She was concerned about the open inquiry approach because “students do not reach a result, the teacher just requires them to discuss” (lines 48 – 49) the teacher’s question. Pelin also did not like the didactic direct approach because there was no student involvement; nor did she like the guided inquiry approach because there was too little student involvement: “they just use existing knowledge to explain and draw sky diagram based” (lines 52 – 53) on the teacher’s observations.
RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Pelin did not seem to think that there were many impediments to the way she would like to teach her science lessons. She did not indicate that such things as the curriculum or school policy interfered with what she wanted to do. However, she did mention that the availability of science laboratory materials and equipment can be a problem. As an example, with respect to teaching about mass and volume, “I can’t use the laboratory sufficiently” (line 112) because of insufficient equipment. Pelin also noted that discrepancies between the national curriculum and the national evaluation can hinder instruction. As an example, she mentioned that while the national curriculum does not include density (at the grade she teaches), the national evaluation does include questions about “density and its calculation.” (line 120). She also indicated that the time available for construction was a limiting factor.

RQ4: How does the teacher explain her actual classroom pedagogical practices?

When asked about her own teaching, Pelin indicated that she uses dramatizations (e.g., “students pretend to be the Moon, Earth and Sun”) (lines 79 – 80), activities and experiments. She specifically mentioned that students can have misconceptions and that activities can be used to address these. Pelin described using group work for activities and providing opportunities for groups to share their findings. Students “present their findings in four-five minute presentations or they prepare PowerPoint presentations.” (lines 77 – 78). Sometimes she has students bring materials from home, such as plants. She also uses modeling. Pelin indicated that her practice is to summarize “topic at the end of the class.” (line 41). She also uses videos or simulations when activities or experiments are not practical. For example, students might not be able to observe “the positions of the sun, moon, and Earth” (lines 58 – 59) and therefore a video can be helpful. She noted that videos also can be used to reinforce instruction. Pelin also likes to use concept maps for wrapping up a unit or an experiment. She noted that in a “successful class” (line 100) students can be taught “vocabulary beyond the textbook,” (line 101) and in such cases, she guides “them using alternative vocabulary.” (line 101). Pelin noted that she sometimes keeps student’s projects that are particularly good to use them as examples for the next year, because
next year they may not be able to “benefit from a laboratory or prepare models.” (lines 113 – 114).

Pelin also indicated that “when students perform an experiment, they learn better through gaining experience.” (line 138). For her fifth graders, the experiments she speaks of are direct instruction. “I write the experiment topic and directions (step-by-step) on the whiteboard.” (lines 139 – 140) “I need to explain each stage.” (lines 140 – 141). However, she allows her sixth-graders to “set up an experiment in performance themselves.” (line 141). Pelin is still involved in that she prepares “a discussion platform before doing the experiment. I also perform the experiment. I wrap-up the experiment if we face any problems concerning results.” (lines 142 – 143). On the other hand, her instruction for seventh and eighth graders is directed towards “standardized test preparation.” (line 146).

Workshop

Pelin indicated that she liked the workshop that she was attending and that it showed her “very interesting experiments and activities.” (line 154).

Summary Statement

Pelin’s interview comments indicate that she is a teacher who is very much inclined toward active direct instruction, although her histogram is more balanced (1DD, 3AD, 3GI, 3OI). She is a teacher who values the involvement of students with activities, but under her direction. She is quite concerned that students learn the objectives for the lesson, which is why she emphasizes the need for the teacher to conduct a lesson wrap-up, otherwise “students could miss learning objectives because they do not know the unit well enough.” (lines 95 – 96). Pelin is also a teacher who approaches fifth grade and sixth grade science much different from seventh and eighth grade science. With seventh and eighth grade science, her instruction appears to be focused on standardized test preparation.
Summary of Hale

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Hale chose the direct didactic option. Referring to her own instructional practices, she says that she will often “repeat learning objectives at the beginning of the lesson and end of the lesson. Otherwise, students don’t revise what they have learned themselves…. I relate learning objectives with specific concepts in the unit.” (lines 77 – 79). Hale rejected the more inquiry instruction options because they require too much time (“it means losing time for me”) (line 84).

Similarly, regarding item 9, Hale preferred a more direct instructional approach. She chose the active direct approach saying that this was similar to how he taught photosynthesis. Hale explained, “I define what factors play a role in photosynthesis… and then students perform the experiment.” (lines 3 – 5). She notes that for the experiment the students follow the teacher’s directions. Hale rejected the direct didactic approach because he did feel that the activity was important. On the other hand, she rejected the open inquiry approach because “I don’t have enough time following this way.” (line 13). Hale was clear that time limitations were important to her (“I can’t give more time… to the learning process. I can’t spend more time for experiments. Therefore, I explained and defined specific concepts…”) (line 28 – 29).

Regarding item 10, and contrary to her responses for items 2 and 9, Hale preferred the open inquiry approach. She says, “I really like to discuss about an issue with my students” (line 40) “I promote inquiry-based learning for my students.” (line 42). However, Hale specifically noted that the grade level with sixth grade where “there is no worry about time concerning anxiety of standardized test. These students are keener than upper classes.” (lines 43 – 45). She was also concerned that other options did not “promote students’ thinking about the topic.” (line 52).
**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Hale’s school is in a rural area and she indicated that a lack of materials can be a barrier. She also cited time limitations and the need to prepare for exams. She also indicated that students were poorly prepared for techniques such as concept mapping and she indicated that students do not always do their homework. Hale also indicated that “students’ parents don’t care…” (line 95) and that “Some students are less motivated.” (line 95).

**RQ4: How does the teacher explain her actual classroom pedagogical practices?**

When asked about her own teaching, Hale indicates that he distinguishes between grade levels. For example, for eighth grade she indicated that her instruction was a direct instruction; for example, “I begin the class with my lecture. I emphasize and explain important points… related with the standardized test;” (line 33 – 34) but she follows direct instruction with experiments and uses “provocative/thinking” (line 35) questions. Hale uses modeling and focuses on “reinforcement and exercises.” (line 74). It is clear that he uses more direct instruction approaches with eighth-graders due to the eighth-grade standardized exam.

On the other hand, when talking about teaching sixth grade science she is much more inquiry instruction. Hale likes to arouse student curiosity. She likes to have student discussions where at the end of the lesson he provides the “correct explanation related with their prior knowledge.” (line 56).

Hale also indicated that she likes to have students work in groups and that she uses dramatizations. She provides online resources. When possible “we perform experiments.” (line 113). Hale says that she tries to promote thinking through the activities they do and through a “question and answer teaching method.” (line 114). She also believes that is important to help students relate “knowledge with their daily life situations.” (line 118).
Workshop

Hale said that the workshop he is currently attending had not changed her mind about teaching but did give her more activities to think about.

Summary Statement

During her interview, Hale chose both inquiry instruction and direct instruction options, consistent with her histogram (2DD, 3AD, 3GI, 2OI). She appears to be a teacher who looks at teaching pragmatically. Because of the standardized exam system, she uses more direct instruction methods with his eighth-grade students because she believes that inquiry methods require too much time. On the other hand, with sixth graders, where there is no exam pressure, Hale uses more inquiry instructional approaches. However, she does not use some activities such as concept mapping because she finds the students unprepared. Hale says that such a technique “requires higher level knowledge and thinking skills from students.” (line 91).
Summary of Hande

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, the Hande chose the open inquiry option “because the students explain their own ideas of what was important or interesting. Thus, were able to provide permanent learning for them.” (lines 82 – 83). She rejected the direct instruction approaches because “the teacher restated the learning objectives and related [them] with specific concepts,” (lines 85 – 86) when she expected that the students would do this. She didn’t choose the guided inquiry response because she did not feel that it required students to “explain their important or interesting ideas.” (line 87). He did not have enough student involvement.

As with items 2, for item 9 Hande chose the open inquiry response, “because the students decide how to set up plants and lights.” (line 3). It would seem, however, that she finds some role for direct instruction because she precedes this comment saying, “I thought that the teacher must have given information about this topic. Therefore, the students are able to conclude themselves.” (lines 3 – 5). In other words, her choice of the open inquiry option is dependent upon the teacher having completed some direct instruction. Indeed, she did not exactly reject the active direct response in that she said that “it is good” (line 7) but it was not the best option, in her opinion. Hande also thought that the guided inquiry option was good because it has the students doing the activity, but then the “teacher explain [the activity objective] fully.” (line 11). After talking about the options, it appears that Hande actually favors guided instruction the most. She says that she would “like to merge [the open inquiry option] and [the guided inquiry option],” (line 13) explaining that she prefers for students to “set up the activity in the classroom as they did in the [open inquiry option]” (lines 13 – 14) and then at the end have spleen “the process fully as in [the guided inquiry option].” (lines 14 – 15) “I prefer students do the activity themselves in the classroom and then the teacher should explain the process.” (lines 17 – 18).

Regarding item 10, once again Hande chose the open inquiry response, “because the students thought about the question and shared their ideas. They also discussed about their ideas.” (lines
Again, she indicated that she also likes the guided instruction option and the reason was the student involvement; she wants students to “do observations themselves and explain their ideas.” (line 50). She rejected the direct instruction options, “because the teacher told them the answer directly.” (lines 52 – 53).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Hande indicated that time and class size can be a barrier to instruction. She noted that “students are not able to perform the experiment themselves in a crowded classroom;” (lines 106 – 107) therefore she has to “perform the experiment on behalf of them and they observe it.” (line 107). She also indicated that students’ lack of motivation can have a negative impact on her teaching: “my school is in an area that poor and uneducated people live in. My students are not interested… because of their families don’t care about school.” (lines 28 – 29). Thus, she says “I spend additional time to motivate my students to the lesson. Therefore, I generally have limited time to complete the unit.” (lines 107 – 109). She also indicated that students “have inadequate prior knowledge from previous years.” (line 30 – 31). She concluded saying, “I perform the experiment myself and barely ask [the students] their thoughts. (109 – 110).

**RQ4: How does the teacher explain her actual classroom pedagogical practices?**

When asked about her own teaching, Hande indicated that she uses laboratories, videos, websites, and textbooks. She specifically mentioned using “activities from the textbook.” (line 39). After using videos or websites, Hande explained that they “discuss about what we have seen.” (lines 76 – 77). It seems to be her practice that she ends lessons by providing explanations: “last I need to explain (sometimes I require them taking notes) the [the activity objective] and conclude myself because of their lack of motivation/interest and inadequate prior knowledge.” (lines 77 – 79). She says “I ask [the students] some questions and require them to do some activities about the topic…” (lines 71 – 72) “I prefer students do the activity themselves in the classroom and then the teacher should explain the process.” (lines 17 – 18). She says that she generally follows a “question-and-answer teaching method.” (line 113). She says her lectures
or like “a conversation with [her] students. They really like to talk about their experiences.” (lines 117 – 118). She says that “discussion is also another comfortable teaching approach.” (lines 118 – 119). She explains that “when starting a conversation with… a word such as ‘electric,’ my students like to continue talking about it. So, I wait for them to share their ideas about the specific concept.” (lines 119 – 121).

**Workshops**

Hande had previously attended a workshop on teaching about space where she improved her “content knowledge concerning astronomy.” (lines 125 – 126). She learned things that she could “talk about in the classroom.” (lines 126 – 127). At the current workshop, she was learning that she “should attach more importance to inquiry-based teaching,” (line 130) and that teachers “are sometimes impatient to wait for students to find the answer or comprehend specific concepts themselves.” (lines 131 – 132).

**Summary Statement**

Hande appears to be a guided inquiry-oriented teacher, which is consistent with her histogram (5GI; 5OI). However, her view of inquiry involves considerable direct instruction. After all, while she seems to endorse inquiry instruction, she also says, “I perform the experiment myself and barely ask [the students] their thoughts.” (line 109 – 110). It seems that she feels herself constrained by her students’ lack of motivation and inadequate prior knowledge. Therefore, she has to spend time motivating her students and she subsequently will often do activities as demonstrations. Her reasoning for inquiry oriented instruction appears to be student involvement though she does not say why she thinks this is important other than by using it “we are able to provide permanent learning for [the students].” (line 83).
Summary of Ceren

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Ceren chose the open inquiry response. She felt that the open inquiry approach is more interesting for students, which is important “because students do not forget what they learn they are interested. Their learning goes on due to their curiosity.” (lines 85 – 86). On the other hand, because this was a wrap-up lesson, she felt it would be important for her to “tell [the students] the original learning objectives” (line 93) and then have the students “find important central ideas of the unit themselves.” (line 94) “I would give [the students] clues during this process. Otherwise, it is hard for all students to relate” (lines 94 – 95) learning objectives with central ideas. Ceren did not like the guided inquiry approach because she felt that the students needed to be reminded by the teacher what the learning objectives were. She did not like the direct approaches because she felt that direct instruction should come later in the lesson: “first, students should find important and interesting ideas… then the teacher can restate the learning objectives and require [the students] to relate the concepts with each learning objectives through the drawing of concept maps.” (lines 96 – 98).

Regarding item 9, as with item 2, Ceren preferred the open inquiry approach because it “provides an opportunity to the students to think more about the activity.” (lines 3 – 4). The students are more involved in the teacher: “students decide how they set up plants and lights instead of the teacher.” (lines 4 – 5). Ceren did not like the direct approaches because they were to direct instruction. She liked the guided inquiry approach but preferred the open inquiry approach because there was less teacher involvement: the “students have freedom.” (line 12).

Regarding item 10, Ceren again preferred an inquiry approach, though this time the guided inquiry; though again saying that she liked both the guided inquiry in the open inquiry approaches. She noted that the inquiry options provide “more freedom to the students for explaining and discussing” (line 47) but also noted that teachers need to “give some explanations and guide [students].” (lines 48 – 49). Ceren did not like the direct instruction approaches.
because those approaches “give the answer directly.” (line 58). Using a direct approach, the teacher does not “give [the students] time to think about the question. This situation decreases their curiosity about the topic.” (lines 58 – 59).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Ceren indicated that there were barriers to instruction. She indicated that she did not have sufficient basic laboratory materials or equipment. She mentioned not having precision scales, or dynamometer, or even litmus paper. According to Ceren, the school budget from the government is insufficient. She mentioned that class size is a factor: “I spend less time student in a crowded classroom … If I share more time with my students, we can communicate better and [student] success increases.” (lines 111 – 113). She also said that time was a factor: there is not enough time. She is required to focus preparing students for standardized tests. Ceren also mentioned personal factors such as whether she likes a topic and desires to teach it; and she commented that the teacher’s knowledge of a subject is important.

RQ4: How does the teacher explain her actual classroom pedagogical practices?

When asked about her own teaching, Ceren indicated that she believes that it was important for the teacher to “evoke [student] prior knowledge or experiences,” (line 18) or “if students face a problem or difficulty, the teacher should give them some clues.” (lines 19 – 20). Ceren should be supportive such as leading the students “a little bit through performing the experiment.” (line 34).

Ceren uses group work for doing activities and then “students compare and interpret their experiment results.” (line 40). When teaching about the move, she requires her students “to observe phases of the moon during the month,” (line 82) and she has them draw diagrams. However, sometimes the teacher presents an “experiment through a Smart Board and… requires them to interpret it.” (lines 41 – 42). She sometimes uses games as an instructional device.
Ceren likes to ask a “thinking question,” (line 46) and says that it is a method used by teachers. When asked how she would teach a lesson she said that she “would ask [the students] a provocative question to arouse curiosity.” (line 54).

Ceren emphasizes learning about the nature of science and the relationship of science to the socialized of students over content: “being a science teacher means teaching the nature of science… and relating a science topic with the social life” (lines 60 – 62) of a student.

**Workshop**

Ceren said that she had attended workshops and that she had learned about educational games and activities, and the importance of structuring instruction “from simple to complex.” (line 146).

**Summary Statement**

Ceren’s interview suggested that she is an inquiry instruction teacher, consistent with her histogram (7GI, 3OI). For example, when asked about the use of Smart Board, she noted that they cause “more teacher-based learning.” (line 120). She prefers that the students actually be the ones who use the Smart Board. She prefers that students actually do experiments rather than simulations of experiments. Ceren says that teachers need to love their students and not to judge them and that students should be allowed to speak in class. She likes to ask her students, “what [they] learned?” (line 132).
Summary of Mahmut

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Mahmut chose the open inquiry response “because the students learn themselves to their own ideas of what is happening or interesting” (lines 84–85). However, he said that he “would be worried about what they remember, what they learn and how they explain it” (lines 85–86). He would therefore “require [the students] to report or list as the unit wrap-up” (line 86). He also thought that the guided inquiry option was good but he did not prefer it over the open inquiry option because he thought it restricted “students’ ideas and interests to the important central ideas of the unit and their relationship with original learning objectives” (lines 93–95). He thought that the open inquiry approach “provides more freedom for the students to think and explain about their thoughts in their own ways” (lines 95–96). On the other hand, he did not like the direct instruction approach “because the teacher repeats what he has taught. The teacher dominates the learning process. He restates the learning objectives and relates each of them to the specific concepts” (lines 89–91). Mahmut explained that the problem with such a direct instruction approach is that “the students are not able to achieve meaningful learning because they are passive…” (lines 91–92).

Regarding item 9, Mahmut chose the active direct option “because the teacher explains the concepts… then the students do the activity with the teacher’s directions.” He further explained that the teacher should provide the directions for the activity “because the student is generally too unfamiliar to set up an experiment” (lines 3–5). The students could than “observe and conclude their findings” (lines 5–6). He said that it was important for students to observe and record data so that students could “comprehend [the] scientific process… Moreover, the students are more interested in the topic when they play an active role doing an activity” (lines 9–11). He rejected the inquiry options because there was too little teacher input. Although he considered the open inquiry a “good teaching option” (lines 11–12), Mahmut was concerned that the students would not be “able to decide how to set up plants and lights for the activity because of their low readiness level.” Thus, the teacher needs to give them directions to follow. He did not
choose the guided inquiry response because he “worried about whether the students are able to reach the expected goal if they observed first without any explanation. They don’t know the purpose of the observation” (lines 14–16). He also noted that the inquiry option would take more time given that the teacher would have to correct student mistakes.

In contrast item 9, regarding item 10, Mahmut chose the open inquiry option because in response to the students question he wanted his “students to come up with their ideas and possible explanations and report these to the class” (lines 49–50). He also liked the guided inquiry option because in that option the students also explained their observations (line 53); but he preferred the open inquiry option “because the students discuss about their observations.” He felt that the topic was “suitable for group discussion” (lines 54–55). He thought that the guided inquiry approach had the “students individually explain their observations…” whereas with the open inquiry option “the students have an opportunity to share and discuss about their ideas with their classmates.” He added that “the student should learn to respect different ideas” (lines 56–58). He rejected the direct instruction options “because the teacher answers the question and [thus] decreases student interest” (lines 58–59).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Mahmut indicated that low student readiness and students lack of prior knowledge can restrict his instructional choices. (Line 13, 26, 38) he also noted that the “lack of materials in the laboratory affects [his] teaching” (line 29). “I am not able to benefit from the experiments in the laboratory because of the lack of fundamental materials” (lines 35–36). He explained that he would like his “students to do the activity themselves and control all steps of the activity” (but his students “have inadequate readiness level and prior knowledge” (lines 37–39). He also indicated that parents were not always supportive. He said that he “would like… students to do group work” but “parents are prejudiced about the benefit of group study and they prefer students to study alone” (lines 114–117). He further explained that especially for eighth-graders,
“both students and parents… expect us to prepare them for the standardized test instead of doing more activities… Exam anxiety affects my teaching in the classroom” (lines 117–119).

**RQ4: How does the teacher explain his actual classroom pedagogical practices?**

When asked about his own teaching, Mahmut said that he gives the students the “necessary information and definitions concerning the topic” then and the students “set up the activity together” (lines 43–44). He also uses group work for the students to “compare and discuss their findings” (line 45). With respect to doing activities, Mahmut explained that he has to lead his students and “they follow the directions how they should do the activity” (lines 39–40). But, he says that he feels “comfortable… when doing activities or performing experiments with the students” and that he “really likes collecting data with the students and drawing inferences from their findings by discussion” (lines 130–131). He appears to value giving students opportunities to discuss their own ideas and to “report their ideas in front of the class,” though he would “conclude the topic providing central ideas” (lines 61–62). He thought that an open inquiry method could be used “as an evaluation method” (Line 21). Nevertheless, Mahmut said that he does “not use any innovative approach, technique with eighth-graders.” Instead they limit activities “and rarely perform experiments.” Instead, he has the students “practice… solving test questions” (lines 122–123).

**Workshops**

Mahmut has attended at least one other workshop in the past, which was about using technology in science education. He says that he benefited from that workshop. He said that the current workshop had not changed his ideas very much because he already knew about the benefits of “experiments, observations, an inquiry-based teaching” (lines 142–143). However, he did say that he was learning more effective activities that do not require too much time.
Summary Statement

Mahmut appears to be an inquiry-oriented teacher, but one who believes that there is an important place for direct or teacher centered instruction. He said that he had “adopted a constructivist approach” and knew “the importance of doing activities in the classroom” (lines 137–138). He also seems to be aware of why an inquiry or student-center approach could be important. He notes that with the inquiry approach students learn scientific processes, they are more interested, and they learn to respect each other’s ideas. He also indicates that because they are not passive, their learning is more meaningful. Clearly, he is a teacher who would like to have his students be more involved with laboratory activities. However, he seems to be a teacher constrained by contextual factors. With respect to eighth grade, he even said that he does “not use any innovative approach, technique with eighth-graders.” Instead they limit activities “and rarely perform experiments.” Instead, he has the students “practice… solving test questions” (lines 122–123). As for lower grades, he also believes that he cannot have students work independently because of their low level of readiness and prior knowledge. Thus, he says “I have to lead them and they follow directions how they should do the activity” (lines 37–40). He also feels constrained by the lack of laboratory materials, and thus rather than performing experiments, he uses visuals such as simulations and videos (lines 36–37). His perspective shown in the interview is consistent with his histogram that is spread across all four instructional options (1DD, 3AD, 3GI, 3OI).
Summary of Mert

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Mert chose the active direct option because he likes “to relate the concepts with each other through concept mapping.” (lines 106 – 107). He says that the concept map “provides information about what we will learn during the unit if I use it at the beginning of the unit.” (lines 107 – 108). He can also use the concept map as a schema for summarizing. He said that he might use the didactic direct approach if students didn’t “know how to use a concept map.” (lines 115 – 116). On the other hand, he rejected both inquiry options. He rejected the open inquiry approach saying, “my class is so crowded. In addition, we have unfavorable physical conditions and readiness levels of the students are low. Therefore, I prefer to summarize myself and then [have] students do something.” (lines 111 – 113). He rejected guided inquiry because he as the teacher “emphasize[s] the concepts and their explanations.” (lines 117 – 118).

Similarly, regarding item 9, Mert chose the active direct option. He referred to this option as being similar to what is required in the Turkish system. The “teacher explains the concept and then students do the activity to confirm the relationship…” (lines 4 – 5). He rejected the option that did not have an activity saying that a “well-organized activity can be applied in the classroom.” (line 11). He said that he “would really like students to make an inference after…the activity” (lines 6 – 7) but that this was beyond their readiness level. He noted that “some students don’t have prior knowledge” (line 4) needed for a lesson. “I really want students to infer something about an activity or experiment, but students have different readiness levels.” (lines 40 – 42). Citing the problem of insufficient prior knowledge, Mert said that he would like to use open inquiry and also that he likes the guided inquiry option, but that “[inquiry] is not possible” (line 14) with his students.

As with items 2 and 9, Mert chose the active direct response for item 10. He explained that the teacher in the item “encourages the students to observe and think…” (line 60). The students use “scientific thinking skills and draw diagrams.” (lines 58 – 59). He rejected options that he felt did
not include student observations; “students need to… go outside and observe the moon. And then, they should draw sky diagrams.” (lines 67 – 68). Not doing observations can be demotivating. However, he showed sympathy towards the didactic direct option, saying “I can understand the teacher because there are time limitations and our education system requires us to prepare students for multiple-choice tests.” (lines 71 – 73).

[Note: the reason he gives for rejecting the guided inquiry option suggests that he misunderstood this option.]

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Mert indicated that there were numerous barriers to instruction. These include: low student readiness, inadequate student prior knowledge, limited materials, and the lack of the school laboratory. He noted that overcrowded classrooms are a problem: “sometimes, I can’t benefit from an experiment because of a crowded class size, lack of materials. Therefore, I need to explain the concepts more.” (lines 44 – 46). “I generally explain the concepts and ask questions.” (line 91). He also noted that it is difficult to motivate students attending 7 AM classes. Any noted that at eighth grade there has to be a focus on standardized test.

**RQ4: How does the teacher explain his actual classroom pedagogical practices?**

When asked about his own teaching, Mert said, “I first explain the concepts and then do an activity or perform an experiment. Otherwise, we need to spend too much time and time limitation is a very important issue in the classroom.” (lines 38 – 40). However, before explaining concepts, he tests “their prior knowledge and readiness level by asking questions.” (line 95). He tries to motivate students about the upcoming unit by explaining to “them how the knowledge will be beneficial in their daily lives.” (lines 145 – 146). He uses “thinking questions” (lines 146 – 147) and he gives “positive reinforcement to the students” (line 148) when they are able to make inferences. But, he then returns to “teacher-based teaching for the rest of the students.
He uses homework and he likes to have students prepare poster presentations. He also advises students to consult websites for more information. He ends a lesson or unit by clarifying the concepts he refers to his approach as “student–teacher–student.” (line 104). Mert says “unfortunately” (line 140) he has to use “teacher-based approaches.” (line 140).

Workshop
He was attending his first workshop where he is learning that “small activities could be extremely effective;” (line 158) but he also seems to think that the Turkish system calls for a more direct instructional approach.

Summary Statement
During the interview, Mert consistently rejected inquiry options citing lack of student readiness and crowded classrooms. He is primarily a direct instruction teacher (as his histogram suggests: 2DD, 7AD, 1GI), although he did indicate the importance of activities such as student observations, and he noted the importance of relating scientific knowledge to students’ daily lives. But, he is a teacher who finds that there are many barriers to inquiry instruction.
Summary of Ünal

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Ünal at first chose the active direct response because he thought it was important that the teacher in the item “restates learning objectives” (lines 87 – 88). He liked the use of a concept map for wrapping up saying, “I really like to use concept mapping what I wrap up any. It provides better understand of the connections among concepts … helpful seeing the big picture regarding the unit” (lines 89 – 91). However, he changed his mind to the open inquiry response because the teacher gets the students more involved: “the teacher asks what main things are that [the students] have learned in the unit. The teacher also considers the students’ own ideas of what is important or interesting” (lines 92 – 93). He said that this is similar to how he teaches. Ünal explained that he decided against the direct instruction responses because it is the teacher who “restates the learning objectives and relates with specific concepts” (lines 98 – 99). He further explained that “the teacher doesn’t need to restate the unit… The students should think about the learning objectives and relate them with specific concepts… Otherwise, it won’t be meaningful for them” (lines 98 – 102).

Regarding item 9, Ünal chose the open inquiry response “because the student should follow an experimental procedure” and the students are allowed “to find what happens in figure it out with their own ways” (lines 3 – 5). He concluded saying that, “we aim for student-based learning and we should provide [students] with more freedom during the learning process” (lines 5 – 6). He further explained that students “look at the topic from different perspectives unlike [the teachers]” (lines 6 – 7). He did not like the direct instruction responses because the students are confirming what the teacher has taught. He explained that “the teacher should guide [the students] instead of explaining concepts before the activity” (lines 9 – 10). He also did not like the guided inquiry response because he thought that there was too much teacher (“the teacher fully explains the process. This situation restricts students’ possible explanations and ideas about the activity,” lines 13 – 15).
Regarding item 10, Ünal chose the guided inquiry response because he wanted student involvement. He noted that students have already “learned how the phases of the moon were due to its illumination by the sun different” and he wanted them to relate that knowledge to the question raised by the student. He did not like the direct instruction responses because he “didn’t like the teacher directly answering the [student’s] question” (lines 49 – 50). He argued that the students would thus lose interest in the topic. He said that the direct instruction of approaches do not “encourage [the students] to think and investigate about [the student’s] observation” (lines 51 – 52).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Ünal indicated that students’ prior knowledge can be a barrier to instruction. He commented, for example, that his “students don’t know chemical reactions or don’t like chemistry topics. Therefore, they have difficulty learning the formula for photosynthesis… they lose their motivation about the topic” (lines 26 – 28).

Ünal also considers grade levels. For example, for item 10 he reasoned that the open inquiry response was not appropriate because sixth-graders “could not be able to record their ideas are possible explanations properly without teacher guidance. Then, they could have misconceptions” (lines 53 – 55). He said that sixth-graders can have difficulties and that “they need help when explaining their ideas relating their daily lives” (lines 106 – 107).

He also mentioned the impact of standardized testing. He might plan to do “various activities or experiments” but he needs to be “completely sure” that is students are compared standardized test (lines 121 – 123).
He also noted that lack of materials can restrict what activities they do. Ünal noted that some of the students come from low income families that are not able to apply school materials. He then has to “find alternative materials” for activities and experiments (lines 119 – 121).

Ünal furthermore noted that sometimes school administrators and other teachers are not happy if he does activities with his students because they “complain that we make noise in the classroom” (lines 127 – 128). He also noted that their current textbook does not support activity oriented science is much as their previous textbook that “focused on the 5E learning method” (lines 129 – 130).

**RQ4: How does the teacher explain his actual classroom pedagogical practices?**

When asked about his own teaching, Ünal said that he “supports more activity-based teaching” and believes that “students should have fun in the school for [there to be] meaningful learning” (lines 136 – 137). He said that he tries to find “cheaper, alternative materials” so that he can do activities and that he uses animations, and that he is “always [seeking] new activities and methods to arouse students’ interests” (lines 139 – 142). He also mentioned using modeling. He said that he might “require [students] to prepare a model regarding what seemed” (line 58), and that he would “relate their observations with daily life” (line 61 – 62). He has the students make concept maps where they “relate the concepts with each other and see the big picture” and which also allows him “to determine unclear parts in [the students’] minds about the unit” (lines 109 – 115). He says that he takes into account how prepared students are for a topic. He implied that sixth-graders are not as capable as older grade students, and that his instruction takes such differences into account. He also mentioned that sometimes before an “activity or experiment” he uses visuals such as posters, model simulations (lines 80 – 81).

**Workshops**

Ünal has “attended various in-service science teacher training programs and elective programs” (lines 152 – 153). He says, “I try to use all this knowledge [from the workshops] to enrich my teaching in the classroom” (lines 154 – 155). He explained that before he attended these workshops, he used direct instruction methods but now uses more activities and technology. He
says that, “we science teachers should search for new and more effective activities especially for improving students’ inquiry-based learning” (lines 166-167).

**Summary Statement**

Ünal appears to be an inquiry-oriented teacher, which is consistent with his histogram (1DA, 4GI, 5OI). He reasoned that inquiry types of instruction lead to more meaningful learning and that students are encouraged to think for themselves. He argues that students are more motivated when they are more involved with a lesson. He notes that there are barriers to inquiry teaching such as the lack of materials but he makes the effort to overcome those barriers. Although he mentioned the pressure of standardized testing, he seems to be able to work around the need to prepare students for the standardized tests. It is also a teacher who recognizes the differences among students at different grade levels, and adjusts his instruction to the level of students. And, he appears to be a teacher who has been significantly influenced by the workshops he has attended.
Summary of Zafer

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Zafer chose the guided inquiry option because he “would like to see their important central ideas… Then, I checked whether they relate their ideas with the three learning objectives. Thus, I’m able to see how much they comprehend the unit.” (lines 105 – 107). His concern with the open inquiry approach was that students might not “gain the learning objectives that the curriculum requires.” (line 111). He further commented that was open inquiry, “it is possible their ideas or interests would not relate with expected learning objectives.” (lines 111 – 112). He did not like the direct instruction approach is because they are teacher-based. He wants students to come up with their own ideas “wrong or incomplete,” (lines 119 – 120) and then he would ask questions to help them “find the correct answer.” (line 120). At the end, he “would summarize the unit with their correct answers.” (lines 120 – 121).

Zafer first chose the active direct response for item 9 “because the students confirm that chlorophyll production light induced through an activity. Thus, they discovered how light affects photosynthesis.” (lines 3 – 4). But, then he realized that he had misunderstood two of the options and that in fact he preferred open inquiry option because students themselves decide how to set up the plants and lights. He disagreed with the didactic direct instruction response because he does think that students benefit from activities in every class: “I also encourage my students to do activities themselves.” (line 9). He didn’t like the guided instruction option because that option did not have the students drawing conclusions from their observations. He expects students to be able to do this.

Regarding item 10, Zafer again preferred an inquiry approach though this time his preference looks for guided inquiry. He thought that if the students had trouble with the guided inquiry approach, open inquiry “could be a good alternative teaching option” (line 58) in that “after researching and discussing the question, the students [would be] able to answer the question
easily.” (lines 58 – 59). He rejected direct instruction because that involve the teacher giving answers. He said that such an approach leads to “rote learning and is not my style.” (line 56).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Zafer indicated that there were hindrances to instruction such as the lack of laboratory facilities (“we don’t have a science laboratory”) (line 73) and the standardized testing at eighth grade. At eighth grade, he says that he does activities quickly and that he gives the eighth-grade students “more details and factors concerning” (lines 34 – 35) a topic (such as photosynthesis) that are not in the curriculum but could be on the test. Zafer also indicated that the lack of materials can be a problem: “I have difficulty finding materials about an activity or experiment.” (line 26). Zafer also noted that classroom management can be a problem because they have to do experiments in the classroom rather than in science laboratory. He also noted that sixth-graders may not be adequately prepared for inquiry instruction: “it is difficult to follow a question-and-answer teaching method, especially for thinking questions, for this grade level.” (lines 80 – 81). Zafer also noted that sixth-graders can have difficulties coming to conclusions based on “their findings and observations,” (line 84) and this is because they “gain learning habits like writing or taking teachers notes from elementary or kindergarten teachers.” (lines 82 – 83). He explains that, “unfortunately, thinking and discussing about… intangible concepts with students doesn’t work if there are not enough successful students in the classroom.” (lines 98 – 99). With less successful students, and when there is a “time limitation problem,” (lines 99 – 100) he prefers to have “students do simulations in the computer laboratory.” (line 100). Finally, Zafer says that the school calendar can be a problem. There are some units that have to be taught in May and “because of the spring, the students have low motivation and may be absent from school.” (lines 136 – 137).

RQ4: How does the teacher explain his actual classroom pedagogical practices?

When asked about his own teaching, Zafer said that even with “limited materials, I still try to do the activity or experiment with less or similar facilities. I begin the class with a question or an
activity…” (lines 32 – 33). He described having students “think about a question based on what they have learned and they would share with the class.” (lines 64 – 65). He would then “guide them and [they would] conclude together.” (line 65). However, with sixth-graders Zafer prefers “playing games instead of [the students] thinking and discussing about the concepts.” (lines 87 – 88). He distinguishes between more and less successful students. With successful students, he uses “thinking question and group discussion methods;” (lines 88 – 89) but with less successful students he uses “more visuals such as videos and simulations” (lines 89 – 90). Overall, he says that he is “comfortable when using constructivist teaching methods and [having] students discover the knowledge by experiencing it themselves.” (lines 147 – 148). Nevertheless, Zafer sees a need for some direct instruction. For example, at the end of the lesson after student discussion, he will “summarize the unit with [students’] correct answers.” (lines 120 – 121). “I conclude a unit depending on the learning objectives and specific concepts from the curriculum using student ideas and thoughts.” (lines 142 – 143).

**Workshop**

Workshops that he has attended have not directly related with science education but more to classroom management.

**Summary Statement**

Zafer appears to be an inquiry-oriented teacher, which is consistent with his histogram (8 GI; 2 OI). While he does feel that there are some constraints to his teaching (such as facilities and time limitations, and whether he considers his students last are more successful), he seems nonetheless to consistently use inquiry instructional approaches. When he can, he seems to specifically use inquiry approaches, but when he cannot he still uses inquiry instructional approaches such as games and simulations. It does not appear that he has gained his pedagogical preferences through workshops, including one he was attending at the time of the interview.
RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Osman chose the guided inquiry approach, “because I would like to know my students’ ideas. I should check what I expect from them and what they think. I also asked them why the ideas more important than another one. I want them to find the original learning objectives through their own ways.” (lines 89 – 91). He did not like the open inquiry approach because he implied that there were too little students thinking, saying “I prefer students to make an inference about the unit themselves.” (lines 94 – 95). Osman rejected the direct instruction approaches “because the students don’t do anything. The teacher restates the learning objectives and relates them to the specific concepts.” (lines 98 – 99). He explained that if the teacher “restates learning objectives,” (line 100) the students “repeat the concepts that the teacher mentioned and don’t add anything else.” (line 101). He was speaking in reference to concept mapping.

Similarly, regarding item 9, Osman chose the guided inquiry approach saying, “when teaching, I want students to wonder about the topic. Thus, I am able to increase their motivation.” (lines 3 – 4). He explained that “first, students should do the plant observations themselves and experience each step. Then I would conclude the unit.” (lines 5 – 6). He did not like the direct instruction approaches “because the teacher begins with an explanation of the concepts… I prefer guiding my students to find the answer of the question.” (lines 8 – 10). “I don’t believe presenting the concepts by myself is a good way for [student] meaningful learning… I barely use prescriptive approaches in my classes.” (lines 11 – 13). Osman also approved of the open inquiry approach but had misunderstood the question.

Regarding item 10, Osman again chose the guided inquiry approach (though originally, he chose the active direct approach). He did not like the direct instruction approaches because “the teacher directly tells [the students] the answer and students play an inactive role during the learning
process” (lines 55 – 56) whereas “students are able to understand themselves.” (line 56). He stressed the importance of student observations.

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Osman indicated that time and standardized testing were limitations on his teaching at the eighth grade: “the eighth-grade curriculum includes many topics, but we have limited time to complete them because of standardized test preparation.” (lines 27 – 28). Due to these restrictions, he limits “activities, observations, or experiments.” (line 34). He explained that “we do not have enough time for a long activity… Because of the standardized test, we generally spend less time than other grade levels to complete the unit.” (lines 38 – 40). “Students and parents require us to prepare students for standardized test. We do less activity, observation or experiment and practice more for the exam.” (lines 116 – 118). Instructional materials are currently not a problem: “materials do not influence my pedagogical choices.” (line 76). On the other hand, he says that he does not like the “existing education policy for science education” (line 125) because science teachers “should teach scientific thinking and scientific literacy instead of teaching” (line 127) for simplistic learning.

RQ4: How does the teacher explain his actual classroom pedagogical practices?

Regarding his own teaching practice, Osman wants “students to wonder about the topic. Thus, I am able to increase their motivation.” (line 3 – 4). He says that he uses a “constructivist approach and asks questions to the students” (line 41) so that they “comprehend the topic themselves.” (line 42). “I want them to find original learning objectives through their own ways.” (line 91). “I prefer that students make an inference about the unit themselves.” (lines 94 – 95). He encourages student involvement: “after the students identify their important main ideas, I … require them to share their ideas with [the class].” (lines 104 – 105). He does, however, believe that there is a role for direct instruction, especially at the eighth grade. For example, in commenting on an eighth-grade lesson (item 9), he said “after completing the activity, I would explain the topic.” (line 20). He says that he tries to explain reasons. Regarding photosynthesis, for example, he
says, “I define for them the photosynthesis cycle.” (line 44). He then goes on to ask questions. “Why is it important? How does it happen?” (lines 43 – 44). Osman also explained that after students do an activity he likes to conclude a topic by confirming “correct student explanations.” (line 64). In his teaching, he uses visual resources such as physical models and Internet-based animations and simulations.

Workshop
Osman has not attended any workshops before. He has learned more effective activities from this workshop.

Summary Statement
Although Osman faces pressures to restrict his teaching, especially at the eighth grade, due to the exam system (“exam activated for standardized tests affects my teaching. Students and parents require us to prepare students for standardized test”) (lines 116 – 117), he still tries to use activity-based, inquiry instruction, which is consistent with his histogram (9 GI; 1 OI). He takes students outside to the school playground “because science is life.” (line 122). “We go outside for the speed and velocity unit.” (lines 122 – 123). He sets up a raceway where the students can run and then calculate their own velocities. He teaches his “students how they can perform an experiment and how they can observe scientific processes.” (lines 132 – 133). He says that he feels “comfortable myself if I can provide more freedom for my students in the classroom. Also, I feel good when I increase their motivation and curiosity.” (lines 141 – 142). Osman justifies using an inquiry approach because he believes that it increases student “motivation and curiosity,” (line 142) that increases wonder and students “learn if they wonder.” (line 142). He does not indicate that materials, resources or student readiness inhibit his approaches to teaching.
Summary of Mete

RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Mete chose the active direct response saying that he likes to use concept maps when they wrap up (lines 120 – 123). He did not like the open inquiry approach explaining that it would be difficult for his sixth-graders “to list the main things about the unit without [his] guidance” (lines 125 – 126). He further explained that some of the students could do this but that he needed to consider “student differences when teaching” saying that at this grade level some of the students will have difficulties. He did not like the direct instruction approaches because they are too teacher centered. Mete explained that he likes “more student based, inquiry-based, learning” (lines 130 – 131). However, he expressed concern that not all his students would be able “to identify important central ideas and relate them with original learning objectives” therefore they “are not able to cover all concepts this way” (lines 132 – 134).

Regarding item 9, Mete chose the open inquiry response saying that he wanted students to set up the activity themselves and that “they should observe and figure out what happens and why” (lines 3 – 4) he said that this “teaching option is very similar” to what he does in his class. However, Mete must have misunderstood the inquiry option because he went on to say that he strongly agrees “with the necessity of pre-organized and prescriptive approach for this activity.” He further explained that he knows his students and that “they miss something or forget to do something about the activity when” he is not in control. He says that the teacher needs to explain the activity so that the students do not face a problem about setting up and observing the activity,” which would lead to unsuccessful results (lines 5 – 11). With this explanation, he appears to favor an active direct instruction approach. But, he rejected the active direct response because he wants students to express their “ideas at the forefront of the lesson” going on to say that he prefers student centered or inquiry-based teaching (lines 14 – 15). He found the direct instruction approaches too teacher-centered. With direct instruction, “the teacher does not provide any opportunity for students to share their findings and present them as a conclusion” but that the “teacher does it on behalf of the student” (lines 24 – 25).
Regarding item 10, Mete chose the guided inquiry approach because at the sixth grade they “have enough time to do the activity” and he prefers that his “students observe and explain what they see themselves with their own words. Thus, they are able to learn meaningfully” (line 65 – 68). He rejected the direct instruction approaches as being too teacher centered: “the teacher answers the question… The students are passive participants during the learning process” (lines 75 – 77). On the other hand, he expressed concern over the time it takes for students to share “their ideas and explanations and discussing them.” The time can be too much (lines 78 – 80).

**RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?**

Mete indicated the time was a factor at the eighth grade due to the standardized test; he has the students “practice for the standardized test by solving problems” (lines 34 – 35). He says that he has more time to do activities with fifth and sixth graders because there is no standardized test. About eighth grade he said, “unfortunately I’m not able to follow a similar way for eighth graders. I generally use lecturing” and a question-and-answer teaching method (lines 51 – 53). He said that he would use open inquiry if it were not for the limitations of time (lines 82 – 83).

He also said that “parents are not interested in their children’s education” and that “parents don’t care what their children do about an experiment” (lines 41 – 44). He indicated that he would like to use group work but his “students are unfamiliar with group study because of their low readiness level coming from previous years” (lines 44 – 45).

Mete also said that students can be irresponsible and then he does “not do the experiment with them because they do not follow the directions correctly. Then, we are not able to find correct results” (lines 58 – 60).
Finally, Mete also said that school administrators do not always appreciate the activities that he would like to do. He said that his “school is very successful in standardized tests” and “therefore the school administrator and parents have high expectations from us” (lines 153 – 154).

RQ4: How does the teacher explain his actual classroom pedagogical practices?

When asked about his own teaching, Mete said that one thing he does is “guide [the students] following the steps of the scientific method” explaining that “they are not able to comprehend the steps, for example, hypothesis, procedure, experiment etc., very well” (lines 28 – 30). He indicated that he would use group work and have students discuss their work. Then he would summarize their work (lines 85 – 90).

Mete said that he follows the “learning objectives from the textbook” and that he uses a open question and answer teaching methods based on the examples from the textbook.” Then he tests the students “to evaluate how well they learned the objectives” and he corrects “their wrong answers through a question and answer teaching method” (lines 142 – 146).

He also said that he likes to relate instruction with “daily life situations and technology” (lines 168 – 169).

Workshops

Mete said that he had attended other workshops but not related to science education: “they were about classroom management, learning and teaching techniques…” (Lines 174 – 175). In the current workshop he is learning about “different inquiry-based teaching methods” and how to “benefit from group work and group presentations.” He is also “learn that scientific argumentation is a very helpful method for providing inquiry-based learning” (lines 178 – 181).
Summary Statement

Mete appears to be an active direct-oriented teacher, which is not consistent with his histogram (1AD, 5GI, 4OI). He says that he likes “using discovery based learning instruction” such as using a “question and answer method” (lines 167 – 168). Consistent with his histogram, he thus appears to be a teacher who values activities that he calls student-centered or inquiry; but what he really seems to mean by inquiry is that students are given a chance to share their ideas about an activity, the procedures for which he has fully explained for them. For example, he said that during an activity he would guide students through the steps of the scientific method. His description combines student centered [inquiry instruction] activities along with direct instruction, and thus appears to be more like active direct instruction than inquiry instruction. Mete also seems to be a teacher who is significantly influenced by classroom factors. He uses more direct instruction “when teaching to less interested classes” and uses more questions and activities with “more interested classes” with whom he says he can “benefit from question and answer teaching methods” (lines 157 – 161). Mete provided no reasons for his pedagogical preferences other than classroom and school factors.
RQ2: What are the reasons for this teacher’s pedagogical preferences?

Regarding item 2, Altan chose the guided inquiry response “because when asking students what they remembered about the unit, students generally mention about specific learning objectives. Then they discuss about these learning objectives and the teacher concludes the unit.” (lines 78 – 80). Altan also likes the open inquiry response “because students share their important/interesting ideas about the unit.” (lines 88 – 89). He was concerned however that with the open inquiry approach the students were not relating their ideas and concepts “with the original learning objectives and making inferences.” (line 91). He elaborated that having the students relate their ideas with the learning objectives enables the students “to relate with their daily life and provide permanent learning.” (line 92). On the other hand, Altan did not like the direct instruction approach “because the teacher restates the three learning objectives and relates them with specific concepts. Students don’t do anything during the learning process.” He does not like this direct instructional approach because “may be [the students] have different ideas or explanations in their minds. We are not able to know what they are thinking.” He disapproves of instruction where “students do not actively attend the learning process” (lines 82 – 83) and where they “just match and confirm the learning objectives and related concepts as the teacher taught them.” (lines 87 – 88).

As with items 2, regarding item 9, Altan chose an inquiry option, though this time open inquiry instead of guided inquiry. The reason that “the teacher should give an opportunity to the students to decide how to set up the activity with their own ideas. The teacher should observe students’ ideas and how they lead the process and interpret their findings. Therefore, the teacher shouldn’t get directly involved in the activity and conclusion.” (lines 3 – 6). Altan rejected the direct instruction options precisely because in them “the teacher leads the process… explains the concepts and students just do the activity to confirm the teacher’s ideas.” (lines 8 – 9). Similarly, he did not like the guided inquiry option “because the student should comprehend the process by applying something instead of the teacher explaining it.” (lines 13 -14). He explained that he
“would like students to actively attend to the process and find the results themselves” (lines 9–10) rather than the teacher giving directions and explanations to the students.

As with item 9, regarding item 10, Altan chose the open inquiry response saying that sometimes he followed “this teaching style.” (line 42). He elaborated that “when a student asked this kind of thinking question I asked the other students what they think,” (lines 42–43) and he encourages the students to “share their ideas and we discuss about them.” (line 44). He notes that if student comments are “incomplete” (line 44) by the end of a lesson, he completes and concludes the lesson for the students. On the other hand, he rejected the guided inquiry option because the teacher gave too little information; but then he also rejected the direct instruction options “because the teacher answers the question” (line 50) when in his opinion “students should find the answer to the question themselves.” (line 50).

RQ3: What contextual factors impact the teacher’s implementation of classroom pedagogical practices?

Altan indicated that the lack of materials can be a barrier. He explained that his school is in a small city; “therefore, I and my students have difficulty finding necessary materials or equipment to perform any experiment. If I things are necessary, we generally find three or four of them.” (lines 104–106). If he is unable to find alternative materials, then they have to “skip the experiment” (lines 106–107) and rely on visuals such as videos and presentations.

RQ4: How does the teacher explain his actual classroom pedagogical practices?

When asked about his own teaching, Altan said he uses either demonstrations or he has his students perform experiments. For example, Altan said that for a lesson like the one on photosynthesis he would first “provide [the students] with prior knowledge concerning what photosynthesis is and what factors influence it.” (lines 36–37). He would then have them “test the factors” (line 37) with plants at home. Later the students “bring the plants to the classroom and explain what and why happened.” (line 38). Altan explains that if the students’ explanations
are correct he “verbally reinforce their success.” (line 39). However, is a give an “inadequate explanation,” (line 39) he completes their explanation. He also explained that he will sometimes “begin the lesson asking interesting thinking questions relevant” (line 70) to the topic. He draws “their attention to the topic” (line 71) and encourages discussion “about their ideas with each other.” (line 72). He sometimes uses models. For example, for a moon phases lesson he says, “I show them and Earth–Sun–Moon model and the students dramatize the model in front of the class.” (lines 73 – 74). He said he likes to use dramatizations.

He also likes to use discussions: “I ask students their own ideas… we determined their important/interesting ideas. Then we talk about how we are able to relate their ideas with daily concepts.” (lines 114 – 116). He explained that discussions are for students to “reflect their thoughts” (lines 125) while he coordinates the discussion. He moderates “the discussion and provides classroom management.” (line 126). Altan says that he is “comfortable using a discussion method while teaching and concluding the lesson.” (line 120). He notes that by using a discussion method “all students whether they are successful or unsuccessful actively attend the learning process.” (lines 121 – 122).

Altan also uses videos “because children are interested in media and understand better.” (lines 74 – 75). He explained that after viewing a video they have a class discussion that ends with him evaluating “their ideas and correcting them if it is necessary.” (lines 53 – 54). Sometimes he also requires the students to take notes. For example, sometimes he gives them 15 minutes for “writing central ideas of the unit in their notebooks.” (lines 116 – 117).

**Workshops**

Altan said that he had attended “a workshop concerning science teaching techniques” (lines 131 – 132) but that it was not much help. What he liked was the opportunity to talk with his “colleagues relevant to their teaching approaches.” (lines 133 – 134). He said, however, that he is benefiting from the current workshop. He has been concerned about time limitations but with the
current workshop he believes that he will be “able to do some activities in the classroom even though there are time limitations.” (lines 139 – 140).

Summary Statement

Altan appears to be a guided inquiry-oriented teacher that also uses some direct instruction, which is consistent with his histogram (2AD; 6GI; 2OI). He clearly sees that a teacher has a role in wrapping up a lesson and making sure that students come to a correct understanding of the lesson objectives. While Altan sometimes chose an open inquiry response, what he appeared to be responding to was student activity. He strongly favors student involvement in the lesson, but he also considers the teacher to have an important role – he does not think that a teacher’s role is minimal. He seems to be an inquiry instruction teacher who uses inquiry to encourage student involvement in the lesson and then direct instruction to ensure that they have come to a correct understanding of the learning objectives. He does not offer reasons for his instructional preferences other than those students learn better with the approaches he describes.