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INQUIRY-BASED INSTRUCTION IN SECOND GRADE CLASSROOMS IN HIGH AND LOW SOCIOECONOMIC STATUS SETTINGS

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INQUIRY-BASED INSTRUCTION IN SECOND GRADE CLASSROOMS IN HIGH AND LOW SOCIOECONOMIC STATUS SETTINGS

By

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ABSTRACT

INQUIRY-BASED INSTRUCTION IN SECOND GRADE CLASSROOMS IN HIGH AND LOW SOCIOECONOMIC STATUS SETTINGS

By

Alison Knight Billman

Inquiry-based instruction has a long history in education. It is a method of instruction that has been recommended across theoretical perspectives and across and within subject matter domains. Indeed, inquiry-based instruction is included in language arts, science, and social studies state standards. However, school districts face increasing demands that may lower expectations for instruction in content areas in which inquiry-based methods are more commonly recommended. Additionally, the implementation of inquiry-based instruction, like so many other kinds of instruction, may be complicated by socio-economic factors. Little is known about the amount or characteristics of inquiry-based instruction implemented in primary grades. This descriptive study sought to describe the degree and characteristics of inquiry-based instruction implemented in second grade classrooms and to describe any differences, if present, in the implementations of inquiry-based instruction in high- and low-SES classrooms. The Inquiry-based Observation Protocol (Billman, 2006) was the primary instrument used to document instruction.

Results from this study indicate there is little inquiry-based instruction implemented in second grade classrooms. Inquiry-based instruction was observed during language arts, science, and social studies instruction with more inquiry-based instruction observed during language arts instruction, followed by science, and then, social studies. Proportionately, more social studies instruction used inquiry-based instructional methods.

Language arts inquiry-based instruction contributed the smallest proportion of minutes to the overall total observed in that domain. Although six phases of the inquiry process were observed, nearly half of all observed inquiry-based minutes were spent collecting data. Reporting was the second most observed phase and constituted the greatest amount of time spent in social studies inquiry-based instruction. The least amount of time was devoted to analyzing or reflecting.

When inquiry-based instruction was observed, there were more minutes devoted to this type of instruction in high-SES classrooms; however, that difference did not reach a level of statistical significance. Differences between groups lay in the characteristics of inquiry-based instruction. High-SES classrooms were more likely to give children opportunities to contribute to, or make decisions that determined the directions of the investigations, to make choices, and to compose text. These SES differences mirror results documented in other studies describing SES differences in classrooms and suggest that, in this case, inquiry-based instruction is implemented in ways that support social reproduction (Anyon, 1981; Duke, 2000).

A number of limitations as well as directions for future research are discussed in light of these findings. The findings reported in this study suggest that further research is needed to understand what teachers know about inquiry-based instruction and how to better help them implement this method of instruction.

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CHAPTER ONE

Introduction

Inquiry-based instruction has a long and elaborate history in education. It is a method of instruction that has been recommended across theoretical perspectives and across and within subject matter domains (e.g., Dewey 1910; Joyce, 1972; Kilpatrick 1918; Llewellyn, 2002; Postman, & Weingartner,1969; Wells, 2000; Zuckerman, Chudinova, & Khavkin, 1998). Today there are multiple definitions and interpretations of inquiry-based instruction (e.g., Abd-El-Khalik, Boujaoude, Duschl, Mamlok-Naaman, Hofstein, Niaz, et al., 2004). In fact, different terms are used to identify very similar instructional approaches: for example, project-based, inquiry-based, integrated curriculum, applied learning, and research workshop (e.g., Alvarado & Herr, 2003; Diffily & Sassman, 2002; Erickson, 2003; Katz & Chard, 2000; Rogovin, 2001; Saul, Reardon, Pearce, Dieckman, & Nuetze, 2002; Short, Schroeder, Laird, Kauffman, Ferguson, & Crawford, 1996; Wolk, 1994). Many of these terms describe similar step-by-step inquiry processes initiated by a question, followed by a number of research related steps that includes a report of the findings. The term, inquiry-based instruction, is used in this paper to refer to this general definition. (See Chapter Two for a more in-depth description of inquiry-based instruction.) At the same time, there are critical differences across the explanations of these approaches, especially in the interpretations of the roles of content, and the roles of teacher and children. Given how widely inquiry-based instruction is recommended, along with the multiplicity of definitions and interpretations

of this method of instruction, to what degree and how do teachers implement inquiry-based instruction in second grade classrooms?

Factors Supporting Implementation of Inquiry-based Instruction

Many factors contribute to or support the implementation of inquiry-based instruction. Some propose inquiry-based instruction as the method of choice for teaching certain subjects. For example, the hallmark of science curriculum movements during the late 1950's and the 1960's, inquiry is still considered a critical feature of science instruction (e.g., Etheredge & Ruditsky, 2003; Joyce & Weil, 1972; National Research Council (NRC), 1996, 2000). Science educators' concern is that children learn science content and also learn how to engage in the analytical thinking processes that scientists use. Inquiry-based methods are used to engage children in the practices of science in order to learn scientific concepts and to learn scientific habits of mind (e.g., Etheredge & Ruditsky, 2003).

Generally speaking inquiry-based instruction is also noted for its potential to trigger or support known contributors to learning and achievement. As a case in point, inquiry is recommended as a method that promotes motivation to engage in learning. That is, it is considered a method that tends to create a desire to learn (e.g., Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Brophy, 2004; Jalongo, 2007). Capitalizing on the power of a child's interest to motivate learning, some variations of inquiry-based methods involve children in asking personally relevant questions—questions that are rooted in the interests of the child (Mills, O'Keefe, & Jennings, 2004; Rogovin, 2001; Wells, 2001). Researchers report that children who are motivated and interested in the work of the classroom are more likely to show greater achievement.

(e.g., Hidi, 2001; Renninger, Hidi, & Krapp, 1992; Schiefele, 1998; Schraw, Flowerday, & Leyman, 2001).

Another perceived benefit of inquiry-based instruction is the opportunity to integrate curriculum subjects within one project or unit of study. Concept Oriented Reading Instruction (CORI) is an example of integrated literacy and science instruction designed to include inquiry processes. Specific lessons are planned for children to personalize their work by asking their own questions related to the content being studied (e.g., Guthrie, Van Meter, McCann, Wigfield, Bennett, Poundstone, et al., 1996; Guthrie, Wigfield, & Perencevich, 2004). These questions guide reading choices as children gather information to answer their questions and eventually report their findings. Because CORI involves many practices, the success of CORI cannot necessarily be attributed to inquiry methods or activating children's interests; however it is important to note this researched method of instruction has proven to increase children' motivation and achievement (e.g., Guthrie, Van Meter, McCann, Wigfield, Bennett, Poundstone, et al., 1996; Guthrie, Wigfield, & Perencevich, 2004, Swan, 2003). In addition to the CORI model of integrated instruction, other research suggests that integrating literacy and content area instruction enhances children's achievement in both (Bristor, 1994; Cervetti, Pearson, Barber, Hiebert, & Bravo, 2007; Pratt, & Pratt, 2004; Romance, & Vitale, 1992; Roser, & Keehn, 2002; Shamlin, 2001; Whitin, 2007).

Inquiry-based methods are also noted for opportunities for engaging children in the kinds of reading and writing they will encounter in the world outside of school—authentic literacy practices (e.g., Erickson, 2003). Research suggests that engaging children in authentic literacy practices supports their literacy development (e.g., Nolan,

2001; Purcell-Gates, Duke, & Martineau, 2007; Purcell-Gates, Jacobson, & Degener, 2004). Considering the range of opportunities for incorporating authentic literacy practices in an inquiry-based framework for teaching and learning, it is possible that this method of instruction contributes positively to children's engagement and achievement in the classroom. Given this, and the range of other facets of inquiry-based instruction argued to be beneficial to children, it is important to understand to what degree and how inquiry practices are implemented.

The educational significance of inquiry-based instruction is underscored by inclusion in curricula and in standard documents mandating curricula across the nation (Academic Benchmarks, 2008). Specifically relevant to this study are the standards documents that guide instruction in the state of Michigan. Inquiry-based instructional methods have been included in the Michigan K-12 language arts, social studies, and science standards for over 10 years (Michigan Department of Education, 2008). For example, a 2004 second grade set of social studies standard reads as follows:

> V.2.1 Pose a question about life in their school, neighborhood, and local community.
>
> V.2.2 Gather and analyze information in order to answer the question posed.
>
> V.2.3 Construct an answer to the question posed and support their answer with evidence.
>
> V.2.4 Report the results of their investigation. (Academic Benchmarks, 2008).

Inquiry-based instruction is a method of instruction that is recommended, and it is an instructional method included in state standards. However, to date, few studies have broadly examined whether inquiry-based methods are being implemented, how they are

being implemented, or to what degree they are being implemented across multiple curricular domains.

Factors Complicating the Implementation of Inquiry-based Instruction

We do know that school districts across the nation are faced with meeting many demands, sometimes including policy directives such as those of the No Child Left Behind Act of 2001 (Public Law 107-110). In meeting these demands some districts are finding less time or are lowering expectations for including teaching of content area subjects such as science and social studies in the primary grades (e.g., Dolph, Goldstein, Lee, Lepori, Schneider, & Venkatesan, 2007; Saul, 2004). This may lead to less inquiry-based instruction, especially when the subjects getting less attention are those for which inquiry-based instruction is most commonly recommended. We do not know how much time is allotted to inquiry-based, content area instruction in primary classrooms.

Implementation of inquiry-based instruction may be complicated by socio-economic factors. Understanding the disparities in achievement of children from different sectors of our society has concerned researchers for some time. Researchers attempting to bring clarity to these issues have looked in schools across different socio-economic settings. Reports of this research show there can be distinct differences in the curriculum, teaching methods and opportunities to learn in schools serving populations of differing socio-economic status (SES) (e.g., Anyon, 1981; Duke, 2000; Giroux, 1980; Pinar & Bowers, 1992; Rist, 2000). For example, in a study that examined print environments and experiences in first grade classrooms, not only were there significant differences in the amount and kinds of literacy resources made available to children in high- and low-SES classrooms, but the opportunities and experiences to use these materials were very

different (Duke, 2000). In high-SES classrooms Duke (2000) found a significantly greater number of opportunities for children to write for audiences beyond the teacher. Additionally, children in those settings were more likely to be afforded a choice of what they read and wrote. While the Duke study did not examine inquiry-based instructional methods, some advocate for inquiry-based instructional methods because they provide children with more agency regarding what is studied and because of the opportunities to read and write for authentic purposes. Thus there is some reason to think that whether, and to what degree, inquiry-based practices are implemented may be distinctly different in schools serving different populations. Given the possible differences in instruction due to SES factors combined with multiple explanations and interpretations of inquiry-based instruction, children may be experiencing very different kinds of learning with and about inquiry-based practices.

Research Describing Inquiry-based Instruction

Implementing inquiry-based instruction is challenging for teachers and perhaps even more so for inexperienced teachers (Mills, O'Keefe, & Jennings, 2004; Short, Schroeder, Laird, Kauffman, Ferguson, & Crawford, 1996). For example, adopting inquiry practices may involve adopting new ways of thinking about curriculum, as well as new ways of teaching. That said, there is research demonstrating that inquiry-based instruction results in significant learning gains (Gray, 2001; Klein, Hammrich, Bloom, & Ragins, 2000; Schmidt, Gillen, Zollo, & Stone, 2002; Valadez & Freve, 2002). Even in a situation in which language arts and science were not integrated, children who experienced inquiry-based science outperformed their peers on standardized reading achievement measures (Valadez & Freve, 2002).The results of research studies like this

one suggest that understanding the challenges of inquiry-based instruction, as well as helping teachers to overcome those challenges and increase their use of inquiry-based methods, may have positive results for children.

Researchers seeking to describe inquiry-based practices in classrooms have generally compared approaches within one subject or content area, or have focused on single implementations in single settings (e.g., Bolinger & Warren, 2007; Gray, 2001; Hapgood, Magnusson, & Palincsar, 2004; Kallery & Psillos, 2002; Klein, Hammrich, Bloom, & Ragins, 2000; McCarty, Wallace, Lynch, & Benally, 1991; Samarapungavan, Mantzicopoulos, & Patrick, 2008; Veal & Elliott, 1996; Wells, 2001). Many of these descriptions focus on science instruction. While some have focused on describing specific aspects or persons involved in the inquiry others have described the implementation of inquiry methods in general. For example, Hapgood, Magnusson, and Palincsar (2004) described the implementation of an inquiry-based science unit in which the purpose of the research was to understand second grade children's abilities to provide explanations. Similarly, in a study of kindergarten inquiry science, Samarapungavan, Mantzicopoulos, and Patrick (2008) describe an inquiry life cycle unit in order to situate their discussion of kindergartners' science learning. In these studies, inquiry-based instruction provides the context for the study, but it is not the focus.

There are some reports or descriptions of inquiry-based instruction in specific settings (e.g., McCarty, Wallace, Lynch, & Benally, 1991; Kallery & Psillos, 2002; Veal & Elliott, 1996). For example, Veal and Elliott (1996) researched science instructional methods in rural settings by examining teacher knowledge of reformed science practices—practices including the inquiry process. The purpose of the study was to

understand current practices and then to estimate the likelihood that teachers would implement reformed science practice after they participated in professional development. Analysis of personal interviews, surveys, and notes from the professional development workshops showed that the teachers in this rural district were not familiar with the most recent science curriculum standards or related inquiry-based teaching methods. Additionally, teachers reported a lack of materials or funding to support hands-on instruction. Implications from the research included recommendations for continued science teacher education and professional development. This study gathered information about the presence of inquiry-based practices through teacher interviews and surveys. It did not examine science instruction as it took place in the classroom.

McCarty, Wallace, Lynch, and Benally (1991) focused on understanding cultural differences in relationship to inquiry-based instructional practices. Their study of Navajo classrooms describes the difficulties teachers faced, and the subsequent adaptations to units of study required to successfully engage Navajo children in inquiry-based activities or projects. While McCarty, Wallace, Lynch, and Benally's study provides a rich description of this particular set of inquiry practices, it does not look at inquiry practices in general or across settings.

This study adds to the literature by examining the use of inquiry-based instruction across multiple settings and multiple content areas. Specifically, the questions that guided this research are: (1) To what degree is inquiry-based instruction being implemented in 2nd-grade classrooms and what are the characteristics of this instruction? (2) Are there differences in the characteristics and amount of inquiry-based instruction implemented in low- and high-SES classrooms? If so, what are those differences?

CHAPTER TWO

Literature Review

This study is informed by the theories and perspectives of socio-constructivism. In this perspective learning is understood to be socially constructed; that is, situated in the interactions of people, materials and tools, and the environment (Brown, Collins, & Duguid, 1989; Greeno, Collins, & Resnick, 1996; Lave & Wenger, 1991; Rogoff, 1990; Volet & Simone, 2001; Wells, 2000). In that sense, classrooms are dynamic and social communities in which members have roles and responsibilities. Learning occurs as the members participate in joint activities. Observing the ways that children and teachers participate in the activities of the classroom, along with the discourse of the community, provides insights into what is being studied, how it is being studied, and how the roles and responsibilities of the members are enacted. Observations for this study were conducted using the Inquiry-based Observation Protocol (IBOP) (Billman, 2006), a protocol specifically informed by this theoretical perspective. This protocol is designed for observers to collect information about teacher-student interactions during instruction, the materials and tools being used, and the classroom environment.

Social reproduction theory provides a framework for examining inquiry-based instruction in differing SES contexts. This theory seeks to explain the mechanisms that perpetuate the stratified social structure of industrial societies (e.g., Nash, 2004). Education, as a socially established and supported institution, is seen as contributing to this hegemony. For social reproduction theorists the structure of schools and schooling can allow social inequalities to persist rather than providing equal opportunities for

children regardless of SES (e.g., Giroux, 1980; Rist, 2000). Two explanations of social inequalities in school settings that are particularly relevant to this study involve the structure and use of school resources and teachers' expectations or labeling of children (e.g., Anyon, 1981; Habermann, 1991; Nash, 2004). Specifically, schools are organized and the curriculum is crafted and delivered in ways that ensure members of any particular group succeed in remaining or becoming prototypical members of their group (e.g., Rist, 2000). This may result in differences in the content of the curriculum as well as in how that content is delivered in the classroom. Even when curriculum content is similar across SES contexts, how it is taught and how children are given opportunities to learn may be remarkably different (e.g., Anyon, 1981; Duke, 2000). Habermann (1991) explains what he terms the *pedagogy of poverty*. Within this pedagogy the teachers' interpretations of their roles and responsibilities are closely related to their expectations of children's abilities and potential for success. It is possible that these interpretations are directly linked to the roles and responsibilities that are then made, or not made, available to the children in their classrooms. In that sense, social reproduction theories may explain the differences found in the characteristics and degree of implementation of inquiry-based instruction in different SES settings.

Defining Inquiry-based Instruction

Given the long history of inquiry-based instruction, it is understandable that differing theoretical perspectives have exerted influence on how it is defined and enacted in classrooms. John Dewey, one of the earliest advocates of this pedagogy, believed that connecting meaningful learning experiences to children's lives provided a context for deeper learning (Dewey, 1910, 1990). His discussions focused on inquiry in relationship

to real-life problems and experiences outside of school. Building on Dewey's ideas, William Kilpatrick elaborated on inquiry as a form of pedagogy in the project approach (Kilpatrick, 1918). Later, inquiry provided the avenue for children to discover and construct knowledge in Piagetian related pedagogies (Llewellyn, 2002). More recently, discussions around inquiry-based methods highlight the apprenticeship-like nature of children's participation in communities of practice. In this perspective teachers are more likely to be responsible for scaffolding children's inquiry-based learning (e.g., Baker, 2004; DuVall, 2001; Harste & Leland, 1998; Magnusson & Palincsar, 2004; Pearce, 1999; Wells, 2000; Zuckerman, Chudinova, & Khavkin, 1998). These theorists explain inquiry as a way of being in and experiencing the world. In that sense, the goals of instruction are to foster children's ability to use inquiry-based habits of mind and engage in their own, personally relevant searches for understanding (e.g., Wells, 2000).

Many link inquiry-based instruction to the practice of science (e.g., Etheredge & Rudinsky, 2003; Llewellyn, 2002). While the sciences strongly endorse inquiry, as evidenced in the National Science Education Standards report, inquiry is also recommended as a systematic process for answering questions pertaining to other disciplines such as math, social studies, literature and philosophy (e.g., Audet & Jordan., 2005; Beach & Myers, 2001; Kennedy, 1996; National Research Council, 1996; Seigel & Fonzi, 1995; Wilks, 1995).

A review of many descriptions of inquiry-based instruction reveals that this method has consistently been described as instruction that uses a systematic or step-by-step process of addressing one or more questions to frame teaching and learning experiences. Most descriptions of inquiry-based instruction include at least three basic

phases: questioning, researching, and reporting evidence-based claims. Many explanations expand the phases by identifying and naming steps within the three broad categories [e.g., researching divided into the steps of planning and data collection (Billman, 2007; Llewellyn, 2002)]. Inquiry is described as a recursive process. Findings or answers to one question may lead to a new question and a new investigation. Additionally, the process for answering one question is often not strictly linear. For example, the initial analysis of data may reveal a need to collect additional data. Rather than moving forward to report findings, investigators might revisit the question or the data collection plan in order to proceed with the investigation (Windschitl, 2004).

At the same time, descriptions of inquiry-based instruction vary in at least four distinct ways. First, the roles of children and teachers are understood and actualized from more to less responsibility for carrying out the process in relationship to the emphasis on the process of inquiry (e.g., Hill, Stremmel, & Fu, 2005; Wells, 2001). Implementations that tend to place a high degree of value or emphasis on content tend to place a greater emphasis on the responsibility of the teacher for directing the inquiry (Etheredge & Rudnitsky, 2003; Schmidt, Gillen, Zollo, & Stone, 2002; Their & Daviss, 2002; Worth & Grollman, 2003). In contrast, those implementations that focus a greater degree of emphasis on the process tend to extend responsibility for inquiry across the classroom community. In those explanations teachers are responsible for modeling steps in the process and/or coaching and scaffolding children's experiences as the children gradually assume greater responsibility for investigations (DuVall, 2001; Erickson, 2003; Gray, 2001; Wells, 2000). While endorsing learner directed classroom inquiry, the National

Research Council (2000) outlines these gradual variations in scaffolding and guidance in relationship to science inquiry.

The second and third variations in descriptions of inquiry-based instruction relate to establishing a context for inquiry-based instruction—whether more curriculum or out-of-school based. The first of these two has to do with the origin of questions driving the investigation. In some interpretations of inquiry-based instruction, the questions are presented within curriculum materials or are determined by the teacher (e.g., Howe, 2002; Krajcik, Czerniak, & Berger, 1999; Martin, Sexton, & Franklin, 2005). In other interpretations, questions are chosen by the classroom community (e.g., de Boo, 1999; Katz & Chard, 2000). Cecil and Lauritzen suggest that investigations or projects should emerge from the "spontaneous interests of the child" (1994, p. 18). While the teacher can suggest projects or investigations, the children's choices take precedence. Questions in classrooms implementing the Reggio Emilia approach emerge through the negotiation of teachers and children during the everyday life of the classroom (Hill, Stremmel, & Fu, 2005). Other questions are rooted in relevant issues or problems that exist in the community outside of the classroom (e.g., Comber, Thompson, & Wells, 2001).

A third variation—also related to the context of instruction—is found in how the instruction is positioned in relationship to real world contexts. That is, there is variation in whether the goals of inquiry focus on modeling and understanding content, or are rooted in opportunities to understand phenomena that emerge from children's day to day experiences and questions about the world, or a combination of the two (e.g., Hill, Stremmel, & Fu, 2005; Howe, 2002; Krajcik, Czerniak, & Berger, 1999; National Research Council, 2000; Wray, 1999).

Interestingly, a fourth variation in descriptions of inquiry-based instruction is found in a subtle difference in the interpretation of the inquiry process. This variation tends to present inquiry as a philosophical stance that emphasizes a questioning attitude toward the world. In that sense, IBI inquiry-based instruction is less a specific process for accomplishing teaching and learning of specific content, and more a guide for thinking and learning, in general (Mills, 2001). For example, Cecil (1995) focuses inquiry on the art of questioning, not to come to a conclusion or definitive answer, but to examine the potential field of answers. While a sequential process might be followed, Cecil places less emphasis on reporting exact findings.

Even as there is variation in descriptions and emphases in inquiry-based instruction, there are also consistent features of inquiry-based instruction. Drawing on those consistent features, inquiry-based instruction is defined for this study as instruction in which the teacher engages children in projects or investigations through a systematic or step by step process that includes establishing questions, collecting information, and reporting evidence-based answers or conclusions. I have chosen this definition because these features are represented across multiple explanations of inquiry-based instruction.

Given the variations in descriptions of inquiry-based instruction described above, in this study I examine variation in individual implementations of inquiry-based instruction. These variations fall broadly into two categories: 1) the distribution of roles and responsibilities in the classroom and, 2) the context of the instruction. For this study, roles and responsibilities were examined in four situations. First, the responsibilities of teachers and children were examined on a continuum of more-teacher to more-child responsibility for decision making and implementation of investigations. Second,

classroom discourse practices provided insights into the degree and nature of children's roles in classroom discussions. And finally, when text-based products were created, two responsibilities—composing and recording—were examined based on a continuum of more-teacher to more-child responsibility.

Observations of three sources of information helped to establish the context of instruction. First, the curricular domain of the lessons was identified. Second, all instances of direct instruction observed in a lesson were labeled according to curricular domain and described with attention to the degree of emphasis per domain. This gave insights into the degree of curricular integration. Additionally, instances in which instruction made direct connections to life outside the classroom—for example, interviews with members of the local community—were noted. This, along with the audiences for text-based products—whether more school based or out-of-school based, provided insights regarding the degree of connection to the world beyond the classroom. In the next chapter I discuss in more detail how characteristics and amount of inquiry-based instruction were examined in this study.

CHAPTER THREE

Methods

This descriptive study used systematic observations to document instruction in high- and low-SES second-grade classrooms in Michigan. Systematic observation is a recognized and accepted method for studying teaching and learning in naturalistic settings and has been particularly useful for describing instructional practices (e.g., Good & Brophy, 1997; Waxman, Tharp, & Hilberg, 2004). Additionally, observations have been successfully used to explain differences in instructional methods across differing contexts (e.g., Turner, 1995; Turner & Meyer, 2000). Observational methods allowed me to examine the characteristics and the degree of implementation of inquiry-based instruction as well as the similarities and differences of those implementations across classrooms and across the differing SES contexts.

I focused on second grade because inquiry-based teaching and learning is required in K-3rd grades according to the state of Michigan language arts standards, social studies standards, and science standards. Second grade represents the middle level of this designated group of grades

Participants

Overview

As explained below, a sample of classrooms was constructed to be representative of high-SES districts and low-SES districts. SES was determined using district information regarding free and reduced lunch statistics and adult education. Care was taken to match the sample across SES settings by including equal number of teachers in

each group. The districts participating in this study varied in size and locale and included urban and rural districts. Eighteen teachers—nine each from five high- and five low-SES districts—participated in the study.

District and School Selection Procedures

School districts were purposefully selected from 140 school districts in mid-Michigan. A subset of the 140 districts was designated high or low based on two criteria 1) percentage of children receiving free and reduced lunch and, 2) the education of district residents (parents) 25 years and older (e.g., Entwisle & Astone, 1994). Districts were selected first using the 2006-2007 Michigan Department of Education School Breakfast and Lunch Information (Michigan Center for Educational Performance and Education, 2007). Districts reporting the free and reduced lunch statistic in the 60th percentile or higher were considered "low" on this statistic. Districts reporting this statistic at the 15th percentile or lower were considered "high". The resulting pool of 40 districts was ranked according to percentage of adult residents with less than a high school diploma using the 2003 State of Michigan Report of Educational Attainment for District Residents 25 Years and Over. The range on this statistic was 0% to 33%. Districts were contacted in order of ranking—lowest or highest—to form a sample consisting of five high-SES districts and five low-SES districts (see Table 1).

Sixteen districts were contacted in order to create the sample of five high- and five low-SES districts. In total nine high-SES districts were contacted with five of the nine districts participating in the study. Two high-SES districts declined participation with no specific reason. One declined because they had no teachers willing to participate and one district was eliminated because the available classrooms did not meet the

requirements of this study. Seven low-SES districts were contacted with one declining to participate because of involvement in another university research project, and one reporting that no teachers were willing to participate.

Several criteria were used to select schools within districts. Because this study focused on instruction in regular education classrooms, special focus and magnet schools and/or classrooms were avoided during the selection process. Instruction for special populations or with a particular themed focus can be qualitatively different and adds a complication that would affect the validity of the observations for this study (e.g., the observer might not be able to accurately code instruction that is delivered in a second language or the amount of inquiry-based instruction might be much greater in a science magnet school). Second—because this study examined the similarities and differences based on SES—care was taken to avoid neighborhood schools that fell dramatically outside of any district's average free and reduced lunch statistics. Because adult education statistics were only available at the district level, I was not able to compare individual schools to district data based on adult education.

Participating districts had two different building configurations that were important factors during the selection of schools and teachers. Three high-SES and three low-SES districts were configured with two or more neighborhood schools. In the one district with only two neighborhood elementary schools, both participated in the study. In the five districts with more than one elementary school building, two schools were randomly selected. The remaining four districts combined all pre-K-2 grade classrooms within a district into one building designated the early childhood center. Each of these early childhood centers participated in the study.

Teacher Selection Procedures

Principals were asked to nominate one or two of their teachers who used inquiry-based instructional methods. To facilitate the nomination process principals were provided with a definition and description of inquiry-based instruction along with a general letter about the study. They were asked to use the definition to identify and recommend teachers who commonly engage children in projects or investigations using a systematic inquiry-based process. The explanation described methods of instruction that include establishing questions, collecting information, and reporting answers, results, or conclusions (see Appendix A). The nomination criteria did not include the general teaching quality or years of service of the teacher. Principals in early childhood centers were asked to nominate two teachers, because early childhood centers housed all available second grade classrooms in the district and were generally larger than neighborhood schools. All other principals nominated one teacher.

Seventeen of the teachers nominated in the first round initially agreed to participate; however, one of the seventeen—a high-SES teacher from District C—withdrew due to a family emergency. In that case a third school within the district was randomly selected and the nominated teacher subsequently participated in the study.

In District I two building principals reported they had no teachers to recommend. In this case, two more schools were contacted. While one teacher agreed to participate, the other recommended teacher declined. At this point in the study there were only two and a half weeks left in this district's school year. For this reason, the principals I contacted were reluctant to ask their teachers to participate in the study. At this point, I

made the decision to not contact additional schools in this district. Ultimately, only one school and one teacher from District I participated in the study.

Finally, in order to have equal numbers of high- and low-SES classrooms, only one school building was randomly chosen from District A. The nominated teacher in that school agreed to participate. Thus, the final sample included 18 second grade teachers—nine from high-SES districts and nine from low-SES districts.

Because principals identified and nominated teachers, it is not possible to report how they explained the study to their respective teachers. In the same respect, information is not available about the number of teachers who might have indicated no interest in participating when contacted by the principal, or the number of teachers that felt obligated to participate based on the principal's request.

After teachers agreed to participate, I met with each one to provide a letter containing general information about the study and to discuss the teacher's role. The letter outlined the study and described expectations of the teachers. It did not include details about comparing SES settings. I felt that information might lead some teachers to misinterpret my purpose as wanting to criticize, rather than describe instruction. This, in turn, might lead them to change their practice, and so, impact the results. During the conversation I communicated my desire to describe second grade instruction across multiple classrooms, along with the need to observe instruction typical for each classroom in order to accomplish the goals of the study. With that background information, teachers were asked to identify two typical days of classroom instruction that included no special assemblies, trips, or unusual amounts of time outside of the classroom.

Teachers participating in the study had varying amounts of experience and were mostly female. Of eighteen teachers, sixteen were Caucasian females. One low-SES female teacher was African American and one high-SES teacher was male of Eastern Pacific origin. In general, teachers in high-SES classrooms had less experience overall and less experience teaching second grade than those teachers in low-SES classrooms. Only two high-SES teachers had more than 10 years of total experience while seven of the low-SES teachers had more than 10 years of experience. Similarly, six of the high-SES teachers had four or fewer years of experience at second grade, and six low-SES teachers had more than four years experience teaching second grade (see Table 2). An independent *t* test showed, on average, teachers in low-SES districts had more years of experience overall (M = 19.78, SE = 10.29), than high-SES teachers (M = *6.89*, SE = 6.41. This difference was statistically significant t (16) = 3.19, $p > .05$ with a large effect effect size, r = .62. Additionally, teachers in low-SES districts also had more years of experience teaching second grade (M = 8.33, SE = 4.24), than high-SES teachers (M = 4.89, SE =5.40, however, this difference was not statistically significant t (16) = 1.50, *ns.*

Teachers appeared to vary in quality as well as experience, although not along SES lines. As explained previously, principals were asked to nominate teachers based upon their inquiry-based instructional practices and not in terms of overall teaching quality or years of experience. Based on many years of teaching and observing teachers, my anecdotal impression is that the teachers referred ranged a great deal in their overall quality, from extremely poor to very strong.

Data Collection

Two forms of data were collected for this study—observations of classroom instruction and teacher interviews. Qualitative descriptions of instruction were documented using the Inquiry-based Observation Protocol (IBOP) and detailed field notes. Each classroom was observed for two full days resulting in 18 low-SES observations and 18 high-SES observations.

Inquiry-based Observation Protocol

The primary instrument for this study was the Inquiry-Based Observation Protocol (IBOP) (Billman, 2006) (see Appendix B). This instrument is designed to locate observed instruction within the universe of possible implementations of inquiry-based instruction. The IBOP includes an observation of instruction and a teacher interview protocol.

The IBOP is designed for observing single lessons. During the observation data are collected at the lesson level and the activity level. Lesson level data establish the context of the observed lesson within prior and future instruction. This level also distinguishes the types of curricular content or skills that are present or practiced within the lesson, and which curricular domain is being addressed through direct instruction. Within the lesson, data is collected at the activity level. The activity is the chosen unit of analysis first, because lessons usually include more than one activity; and second, because the instructional purposes of inquiry, along with the teacher and student roles and responsibilities, can change from one activity to the next. The definition of activity that is used for the IBOP is based on the work of Rivera and Tharp (2004).

Boundaries of an activity are defined by its unique purposes and products (Rivera & Tharp, 2004). When the purpose or product of the instruction changes, observers begin

coding a new activity. For example, if a teacher and children are creating a chart that lists possible methods for finding out their pet hamster's favorite food, the purpose is brainstorming methods and the product is a chart listing those methods. That is one activity. If the class is divided into groups, and each group researches the viability of the different methods listed on the class chart, the observer begins coding the instruction as a new activity because the purpose has changed from creating the class list of methods to determining the viability of the methods. For each activity, observers document detailed, qualitative descriptions that include identifying and describing the implementation of steps of the inquiry process.

The IBOP is designed for descriptions of instruction to be translated into nine scales to create an inquiry-based instruction and literacy practices profile for each observed activity. The profile reports on the presence of inquiry-based processes as well as four characteristics of instruction including the presence of inquiry-related language and the creation of text-based products. After observations of lessons are completed, observers follow a series of coding steps to identify first, the presence of inquiry-based instruction and then, if present, to code the characteristics of that instruction. The scales are explained as follows:

Inquiry-Based Processes

Inquiry Practice: The inquiry practice scale reports on the implementation, or not, of inquiry-based phases. If an inquiry-based phase is coded as present during the lesson, the observer proceeds with coding the Characteristics of Instruction for the lesson.

Characteristics of Instruction

(1) Inquiry-based Process Language: This scale reports on the use of inquiry-related vocabulary. IBI language is coded as present or not present.

(2) Context of Instruction: The ratings on this scale represent how instruction is situated in relationship to other curriculum and/or life outside of school.

(3) Roles and Responsibilities: Roles and responsibilities reports on the distribution of responsibility across teacher and children. For example, an activity in which children are planning the steps of an investigation would receive a different rating for roles and responsibilities than an activity in which the teacher provides an outline of steps for the children to follow.

(4) Classroom Discourse Practices: This scale is somewhat related to roles and responsibilities. It acknowledges who is participating in the discourse during an activity, and in what capacity they are participating. For example, rating for a teacher managing a recitation of children's observations would be different than the rating for children talking together in groups to analyze data with little input from the teacher.

(5) Text-based Products: Authors and Audiences: This scale reports on the presence and creation of text-based products during inquiry-based instruction. It is comprised of four sub-scales:

(5a) Text-based Products: The IBOP includes a checklist for observers to note and categorize the text-based products created during an activity. Products can be permanent or not, as in a chart that is created on a white board versus one that is created on a pad of paper. If text-based products are created during an observed activity, the composing, recording, and audience scales are coded.

(5b) Composing: This scale rates the responsibility for composing the text-based product. A report that is written by children independently is coded differently than one the teacher composes using children's verbal contributions.

(5c) Recording: Similarly to composing, this scale rates the responsibility for recording the text. While a text may be composed of children's contributions, the teacher may do all of the recording on a class chart. In contrast, the children might be responsible for recording text the teacher is dictating.

(5d) Audiences: This scale rates the audience for the composed text on a scale of more school-based audiences to audiences based outside of school. A text composed for the teacher to evaluate or grade is coded differently than a letter to the local town mayor.

The IBOP scales are coded in one of two ways. The Inquiry Practice scale, the Inquiry-based Process Language, and the Text-based Product scales are all coded present or not present (with a rating of present for the Inquiry Practice scale necessary in order to

move to any other scales on the instrument). Each of the other Characteristics of Instruction scales has more than two category ranges. Higher scores represent instruction that is considered to be more student-led, curriculum that is more integrated, or instruction that is more situated in an outside-of-school context. A score of one represents instruction that is more didactic, more traditional, or more situated in a single curriculum context. Table 3 provides descriptions of the coding categories for each of the IBOP scales as they were used in analysis (see later discussion). For a closer look at the IBOP see Appendix B.

Reliability and Validity: Internal Consistency. The IBOP activity profile consists of 5 independently reported scales—Inquiry Practice, Inquiry Roles and Responsibilities, Context, Discourse Practices, Process Language—and one composite subscale— Text-based Products, Authors and Audiences. The Text-based Products, Authors and Audiences subscale consists of four items—Text-based Products, Composing, Recording, and Audience (Billman, 2006). Internal consistency of the IBOP including all scales is .78 (Cronbach's alpha; n = 261 activities) at a .001 level of significance. Cronbach's alpha for the composite subscale—Text-based Products, Authors and Audiences—is .85 at a .001 level of significance.

Reliability and Validity: Interrater Reliability. Interclass Correlation (ICC) on single measures was the method of analysis used to calculate the interrater reliability for the IBOP (Billman, 2007). ICC for single measures is the appropriate analysis to report if the instrument is going to be used by single raters (Garson, n.d). Statistics are interpreted similarly to Cohen's Kappa with 1.0 equal to perfect agreement across observers (Fleiss & Cohen, 1973). Values of .60 to .79 are considered substantial reliability, and .80 is

considered outstanding (Field, 2005; Garson, n.d). Interrater reliability for the IBOP is reported at two levels: 1) the identification of the boundaries of activities and 2) the coding of observed instruction for the activity profile. Interrater reliability on the identification of activities within observed lessons is .82 at a .001 level of significance on single measures. Interrater reliability averaged across the items of the activity profile is .73 at a .001 level of significance on single measures.

The current study was based on full day observations while the interrater reliability for the IBOP was established based on observations of single lessons with time frames of 30-90 minutes. Teachers established the boundaries of the lessons—beginning and ending times—that were observed to establish reliability and validity data for the IBOP. In that respect, the interrater reliability for the IBOP was not established for observations in which observers are responsible for determining the boundaries of lessons. Since the full day observations in this study included more than one lesson, this could be considered a limitation when reporting minutes per lesson or content domain. However, lesson boundaries generally seemed quite clear: most of the observed teachers established lesson boundaries by posting daily classroom schedules or directly communicating this information to their children as instruction proceeded. This information facilitated identification of lesson boundaries during the observations. Importantly, the length of a lesson or observation does not interfere with the reliability of the activity profile scores.

Observations

I conducted all observations during the second semester of one school year. When possible, observations were scheduled with the teacher to be at least one week apart

following the guidelines outlined in the IBOP (Billman, 2006). In several cases the time between observations differed, with observations scheduled four to fourteen days apart due to school vacations or the teacher's schedule. Observation dates were scheduled in collaboration with the teacher to avoid special events such as field trips or assemblies and to observe school days when the teacher delivered the most typical instruction. In total, I observed 14,934 minutes of school time with 10,470 of those minutes occurring in the classroom and not designated as special classes or recess.

Each classroom was observed for two full days resulting in a data set of 36 observations—18 observations (7466 minutes) in low-SES classrooms and 18 observations (7484 minutes) in high-SES classrooms. Full days were observed because the relevant literature recommends inquiry-based instruction as a viable method across multiple content areas (e.g., Audet & Jordan, 2005; Beach & Myers, 2001; Kennedy, 1996; Seigel & Fonzi, 1995; Wilks, 1995). Consequently, it is important to observe across the school day to increase the probability that all potential uses of inquiry-based instruction in different content areas are captured. I observed for two days because inquiry-based instruction, by nature, is a complex process of interconnected steps. For this reason, it is likely the process will occur across a sequence of lessons scheduled on different days. Additionally, the IBOP is designed to collect information on a minimum of two lessons in order to increase the potential to observe connected steps in the inquiry process. Following the same format for this study seemed reasonable and important since one full day observation would only provide descriptions of single lessons across subject areas.

During observations I collected two sets of descriptive data: descriptions of instruction using the IBOP, and descriptions of other school day events collected as field notes. All observed content area instruction was documented using the IBOP and coded at the end of each day's observation. Even though some lessons ultimately were not coded as including inquiry-based instructional practices, that information was impossible to know before the lesson began. For events that did not include instruction—for example, morning opening exercises or a teacher reading a book for entertainment—I kept detailed field notes that included the amount of time allocated for the event. Although I did not observe time spent out of the classroom in specials, lunch, recess, and so on, I did document the number of minutes spent in those activities in the record of school day events.

All segments of time in the classroom were labeled. This allowed me to establish how much time was spent for instruction in each classroom compared to non-instruction (e.g., language independent practice, class meetings, and snack break) as well as to make comparisons between time spent and not spent on inquiry-based instruction. Instruction was labeled by content area or content areas it addressed. IBI lessons that included direct instruction from two curricular domains were labeled integrated instruction and then examined for domain emphasis. Lessons labeled as integrated were then examined for whether more time and attention was given to one domain than another during this integrated lesson. For example, I coded one lesson as integrated when the teacher taught science concepts and principles during a lesson in which she also taught language arts skills and processes. In this example, communicating accurate science information set the purpose for learning about and practicing writing processes and skills: however, more

time and attention was devoted to accomplishing the language arts instructional goals. Therefore, this integrated lesson was also coded as language arts—resulting in a final coding of integrated language arts. In this study, language arts received more time and attention in all instances in which two domains were integrated. Events that took place outside of the classroom were labeled according to purpose and included lunch, recess, and special classes.

After each observation I constructed a chronological summary of events according to type of event and number of minutes allocated for the event and reviewed and selected the IBOP documented lessons that showed evidence of inquiry-based instruction. Lessons that included at least one step of the inquiry-process were coded according to the IBOP protocol.

At the end of the school day I asked teachers any questions needed to clarify observations. For example, one teacher made several references to a week of daily trips to a nature center, called the Big Nature Lesson. I asked her, "Would you talk a little bit about the Big Nature Lesson your class took—how you decided to do it, a little bit about the preparation, and then a little bit about what the kids were responsible for or how a typical day went?" Teachers' responses were documented as field notes. Although teacher interviews using the IBOP interview protocol were also conducted as part of this study, analysis of that data did not yield information not already recorded in the observations and are not analyzed or reported for this paper.

Data Analysis

Data analysis involved creating three databases to address questions regarding the amount and characteristics of inquiry-based instruction across classrooms and SES—the

observation summaries database, the inquiry practices database, and the IBOP activity profiles database. In addition, in order to provide descriptions of specific inquiry-based lessons, I reviewed field notes and IBOP activity descriptions and wrote summaries of each inquiry-based lesson.

Observation Summaries Database: Amount of Inquiry-based Instruction

The observation summaries database was used to examine the amount of inquiry-based instruction. Specifically, I used this database to calculate the total number of minutes observed per curricular domain—science, language arts, and social studies (no inquiry-based instruction in mathematics was observed)—and the total number of minutes using inquiry-based instruction (IBI) per domain. I also calculated total minutes for two subgroups of language arts lessons—language arts only lessons and integrated language arts lessons (see previous explanation of integrated lessons). Totals were calculated for each classroom, SES group, and for the entire sample. Additionally, I calculated the proportion of minutes spent using IBI by SES and domain.

I averaged the IBI minutes observed in each classroom to provide a mean number of IBI minutes per classroom. Wilcoxon Rank Sum analysis procedures were used to compare these means across the 18 classrooms (Ott & Longnecker, 2001). Five classrooms did not use any IBI. A further comparison using the same analysis procedures examined SES differences for only those 13 classrooms that used IBI methods. In all cases significance levels were set at $p = .05$.

Pearson's chi square test of independence was used to compare the number of IBI minutes and the number of non-IBI minutes across SES groups with Cramer's Phi used as an estimator of effect sizes (Ott & Longnecker, 2001). Levels of significance were met

here and in all other reported chi square calculations when $p = .05$. Effect sizes were based on Cramer's Phi with values of less than .2 indicating a negligible relationship, values of .2 to .5 indicating an important relationship, and values greater than .5 indicating a strong relationship (Ott & Longnecker, 2001).

Inquiry-based Practices Database

The inquiry practices database includes data from the Inquiry Practice scale. This database was used to calculate the number of minutes spent in each phase of the inquiry process: 1) questioning, 2) planning, 3) collecting data, 4) analyzing data, 5) reporting, and 6) reflecting. Minutes were totaled for each phase observed per classroom, per curricular domain, and SES. Pearson's chi square test of independence was used to compare SES groups with Cramer's Phi used as an estimator of effect sizes (Ott & Longnecker, 2001).

Activity Profile Database: Characteristics of Inquiry-based Instruction

The IBOP activity profile database was used to examine characteristics of inquiry-based instruction. Specifically, this database recorded the use of inquiry-based process language as present/not present and the characteristics of IBI as numerical codes. I totaled minutes for each code category for each of the characteristics of IBI: 1) Inquiry-based Process Language, 2) Roles and Responsibilities, 3) Context of Instruction, 4) Classroom Discourse Patterns, and 5) Text-based Products: Authors and Audiences, which was comprised of the sub-scales 5a) Text-based Products, 5b) Composing, 5c) Recording, and 5d) Audiences. (See Table 3 for description of the category levels for each scale.) Subtotals were calculated for each SES group and each curricular domain.

An inspection of the data showed that minutes were not distributed across all categories for the following scales—Roles and Responsibilities, Context of Instruction, Composing, Recording, and Audience scales. Because chi square requires that all cells are greater than zero, I examined the categories in each of these scales and collapsed categories for three—Roles and Responsibilities, Composing, and Recording—without reducing important distinctions in the categories. The Roles and Responsibilities scale was reduced from three to two categories by combining the two categories in which children are described as having more agency (noted in Table 3 as categories 2a and 2b). The Composing and Reporting scales were reduced from five to three categories of authorship—1) teacher, 2) teacher and children, and 3) children independently. It was not possible to meaningfully collapse the Context of Instruction scale or the Audience scale categories. I used total minutes to describe the Context of Instruction and compare groups. In the case of Audience, all high- and low-SES minutes fell within the same two categories; that is, both groups had the same empty cells in common. This allowed me to run a chi square comparison of the minutes observed while noting the findings in relationship to the empty cells. Thus, I was able to conduct Pearson's chi square analysis for all but one of the Characteristics of Inquiry-based Instruction, the Context of Instruction scale.

CHAPTER FOUR

Results

Findings from this study indicate there is little IBI implemented in second grade classrooms. There were no statistically significant differences in amount of IBI implementation between SES groups, although there were more minutes devoted to this type of instruction in high-SES classrooms. IBI was observed during language arts, science, and social studies instruction with more IBI observed during language arts instruction followed by science and then, social studies. Proportionately, more social studies instruction used IBI methods. Language arts IBI contributed the smallest proportion of minutes to the overall total observed in that domain. Although all phases of the inquiry process were observed, data collection was the phase most often implemented with nearly half of all observed IBI minutes spent collecting data. This was the most common phase observed during science and language arts IBI, with more than one half of all science IBI spent implementing this phase. Reporting was the second most observed phase and constituted the greatest amount of time spent in social studies IBI. The least amount of time was devoted to analyzing or reflecting. While thirteen teachers were observed using inquiry-base methods, no teacher was observed using IBI methods in more than one lesson during one day's observation.

Differences between SES groups lay in the characteristics of IBI. IBI instruction in low-SES settings tended to be more situated in a single curricular domain, while implementations of IBI in high-SES classrooms tended to integrate curricula or include outside of school connections. High-SES classrooms were more likely to give children

opportunities to contribute during discussions or make decisions that determined the directions of the investigations. While there was no difference in the amount of time spent creating text-based products across the two SES settings, children in high-SES classrooms were more likely to be responsible for composing and recording text. There were no SES differences in type of audiences for these texts, and observed audiences in all classrooms were school-based only. The results are presented in three sections: 1) Amount of Inquiry-based Instruction, 2) Implementation of Inquiry Process Steps, and 3) Characteristics of Inquiry-based Instruction. Results are organized or reported by content area as we cannot assume that children would transfer IBI learning in one domain to another.

Amount of Inquiry-based Instruction

Observations across the 18 classrooms resulted in very little documentation of inquiry-based instruction. Of the 14,950 minutes observed, only 855 minutes, or 5.7%, included inquiry-based instructional methods. Of the144 individual lessons, only 17 included inquiry-based instruction. Even though all teachers participating in the study were recommended for their use of inquiry-based instruction; five of the 18 did not use any IBI methods. Nine only used IBI methods during one observation, and only four teachers used IBI methods during both observations (see Table 4).

While teachers in high-SES classrooms spent more time using IBI than low-SES teachers the two groups were not statistically different based on a Wilcoxon's Rank Sum comparison, W_S = 73.5, *ns*, r = -.25. A Wilcoxon's Rank Sum comparison of only those 13 teachers who used IBI was also not statistically significant, W_S = 34.5, *ns*, r = -.25. A Pearson's chi square analysis of those minutes spent using IBI methods in high- and low-

SES classrooms compared to the number of minutes where IBI methods were not used resulted in a significant value of chi square, $X^2(1) = 18.46$, $p < .001$, with more minutes devoted to IBI in high-SES classrooms; however, Cramer's $V = .035$, indicates this significance is negligible. In sum, there was no difference in groups to the extent that IBI was implemented in low-versus high-SES classrooms; however, as will be explained later, there were significant differences in the characteristics of IBI.

While the number of minutes of IBI used in high- and low-SES classrooms was not statistically different, more IBI was observed in high-SES classrooms. Of the 855 total IBI minutes, 489 minutes were observed in high-SES classrooms, or 6.5% of all 7484 high-SES minutes observed, In contrast, 366 IBI minutes, or 4.9% of all 7466 low-SES minutes were observed in low-SES classrooms. Ten of the 17 IBI lessons took place in high-SES classrooms; seven of the lessons occurred in low-SES classrooms.

When comparing the number of IBI minutes in high- and low-SES classrooms it is important to note that one, 190-minute, low-SES lesson occurred on one day and contributed 51.9% of observed low-SES IBI minutes. In this particular case the teacher explained that a change in the state language arts standards modified the requirements for individual children's experiences writing a research report. Rather than have children individually establish a topic, collect information, and write reports, the teacher could direct a whole class activity creating one class report and still accomplish the goals of the standards. Due to time constraints and the district emphasis on preparing children for the state assessments, this teacher and her second grade colleagues made the decision to spend one day on a class research report.

In comparison, the longest high-SES IBI lesson was 90 minutes long and contributed 18.4 % to the 489 minute total of IBI minutes. This lesson also involved language arts curriculum; however, in that lesson the teacher devoted only the language arts block to the research project instead of a whole day, and completed only a portion of the project on the day observed. Outside of the 190-minute low-SES classroom where the entire day was spent completing one IBI project, the length of IBI lessons across the sample shows a tendency for high-SES lessons (M = 65 minutes) to be longer than low-SES lessons (M = 33 minutes).

IBI in the Content Areas

IBI was observed in language arts, science and social studies lessons—all curricular areas that include inquiry-based instructional methods in this state's education standards. Language arts lessons included three lessons strictly devoted to language arts instruction and three lessons integrating language arts and science instruction. These six lessons represent 457 minutes, or 53.5% of the 855 IBI minutes. More language arts IBI lessons (4 versus 2) occurred in high-SES classrooms (see Table 5). Eight of 17 lessons were devoted to science instruction and contributed 316 minutes—or 36.9% of all 855 IBI minutes. More IBI science lessons and more IBI science minutes were observed in low-SES classrooms (see Table 5). While social studies IBI lessons were observed, only three lessons for a total of 82 minutes--or 9.6% of all IBI minutes--were devoted to this domain. All of these were in high-SES classrooms. Observations of IBI instruction in each of these domains is discussed in more detail below.

Language Arts. Language arts instruction was the most frequently observed content area instruction with 3992 minutes devoted to language arts instruction across the

18 classrooms. Although more of the IBI minutes were devoted to language arts, language arts IBI instruction constituted the least proportion of total instructional time for its domain—457 minutes or 11.4% of all language arts instruction observed. Overall, more language arts instruction was observed in high-SES classrooms (2074 minutes) with a greater proportion of those minutes inquiry-based—256 minutes or 12.3% of all minutes were inquiry-based. When averaged, the amount of language arts IBI instruction in high SES classrooms per day equaled 14.2 minutes. Fewer minutes of language arts instruction were observed in low-SES classrooms—total 1918 minutes. Of the 1918 minutes, 201 minutes, 10.5% of all low-SES language arts instruction, were inquiry-based. The average number of IBI language arts minutes per day in low-SES classrooms equaled 11.2 minutes. In respect to language arts IBI in low-SES classrooms, it is important to remember that one of the two low-SES lessons consisted of 190 minutes (see previous discussion). This single lesson contributed nearly all of the IBI language arts minutes observed in low-SES classrooms.

Regardless of SES—children either wrote or were engaged in some stage of writing animal research reports in four of the five language arts lessons. That said, the lessons differed in two ways—first, in the amount of time allocated for writing the report, and second, in the degree to which science instruction was integrated with language arts instruction. (Appendix C presents a brief description of all IBI lessons.) As previously noted, in one low-SES classroom the teacher managed the writing of a single class report, from beginning to end, in just one school day. Across the full day lesson, children helped to establish categories of information and were responsible for listening and recording facts to add to a class chart. However, after classifying the facts, the teacher took full

responsibility for organizing those facts into paragraphs which the children then copied. In contrast, lessons in the three high-SES classrooms either prepared children for writing or involved children in writing one portion of a report. For example, in one lesson children participated in a class discussion and then had the option to work independently or in groups to collect information. In another lesson, children independently wrote a paragraph for a class report. The high-SES classrooms teachers explained that children would complete additional writing steps in future lessons.

A second difference in the group of language arts lessons lay in how two high-SES teachers—notably from different districts—integrated language arts and science instruction. During these integrated lessons children gathered information to write animal reports; however, the reports were directly related to co-occurring science units on habitats. In these integrated lessons, teachers were observed teaching both science concepts and language arts skills and processes. For example, science instruction in one integrated lesson included a discussion of the inter-relationships of animals in the wetlands habitat—predator and prey. This discussion included explanations of how and why features of the habitat serve as protection for certain animals as well as explanations of how animal colorations provide camouflage from predators. The teacher's language arts instruction included explaining how to think about categorizing important details and translating them into paragraphs for a report. During the last activity of this lesson, the children chose one of the categories of information and independently wrote a paragraph to share with the class.

No curriculum integration of this type was observed in the two language arts only lessons—one high-SES and one low-SES—in which children wrote animal reports. The

writing tasks in those lessons included some of the same types of content information about animals—for example detailed visual descriptions of animals and their habitats—and some of the same tasks of sorting and information into categories. However, the instruction in these lessons only focused on language arts skills and processes and did not include direct instruction of science principles or concepts. For example, in the high-SES lesson the teacher provided instruction on different types of informational text—for example books, magazines, internet websites, and videos. Children were then provided with opportunities to view a video for information and read different text-based materials for information. They gathered descriptive information about gorillas, but there were no discussions of this information in relationship to science concepts or principles.

Science. I observed 900 minutes of science instruction across the 18 classrooms with IBI science instruction equal to 35.1 % (316 minutes) of all science instruction observed. Of the 900 minutes of science instruction, 327 minutes were observed in high-SES classrooms and 573 minutes were observed in low-SES classrooms. A greater proportion of high-SES science minutes used inquiry-based methods—151 or 46.1%. IBI science in low-SES classrooms equaled 165 minutes, or 28.8 % of all low-SES science instruction. The average number of IBI science minutes in high-SES classrooms was 8.4 minutes per day; the average number of IBI minutes in low-SES classrooms was 9.2 minutes per day.

In all cases, the lessons coded as science instruction were direct implementations of school district mandated curriculum kits or curriculum guides and included some form of hands-on activity. There was more of this type of science instruction in low-SES classrooms. (As previously discussed, some science instruction was observed during the

integrated language arts lessons that occurred in high SES classrooms. Those lessons are not included in the total minutes of science instruction because teachers spent most of the instructional time and attention on language arts.)

Science IBI lessons took two basic formats: 1) experiments with stated questions or hypotheses that were carried out and documented by groups of children while the teacher provided directions and support, or 2) lessons or activities labeled as experiments by the teacher when no question was stated to drive the experiment. While there was an implied question, this type of lesson took on the characteristics of a demonstration in which children collected observations. In some cases children were also provided with or asked to come to some sort of conclusion or explanation of the phenomenon in question. For example, to introduce a lesson one teacher modeled how to submerge a mirror in water and use a flashlight to reflect light. The reflected light displayed the color spectrum, a rainbow. Subsequently, groups of children carried out the same activity and documented their observations in a science workbook. The teacher referred to this activity as an experiment, although no question or hypothesis was articulated. This lesson came from curriculum materials provided by the Battle Creek Area Math and Science Center (BCAMSC). This second type of lesson was by far the most common type of hands-on science lesson—four of five low-SES lessons and one of three high-SES lessons. (See later discussion regarding the implementation of various steps in the inquiry process for a further discussion of questions and the IBI process.)

I observed all science instruction conducted in classrooms. I did not observe one science lab lesson in a low-SES district. This district, along with one high-SES district, provided additional science instruction in special lab classes. Special lab lessons occurred

in separate classrooms and the science lab teacher planned lessons intended to support in-class science instruction. Only one lab class was scheduled on a day that I observed. I did not observe that lab class for this study because the regular classroom teacher did not attend the class with her children and she was not responsible for any instruction during that period.

Social Studies. Social studies was the least observed curricular area of instruction with a only 217 minutes of the 14,950 minutes of instruction observed spent teaching content within this domain. Although the least observed instruction overall, social studies IBI instruction constituted the greatest proportion of total instructional time for its domain—82 of 217 minutes or 37.8% of all social studies instruction. More social studies instruction in general occurred in high-SES classrooms. One hundred and eight-six minutes of social studies instruction were documented in high-SES classrooms and 82 (44.0%) of those minutes used inquiry-based methods. While 31 minutes of social studies instruction were observed in low-SES classrooms, none of those minutes used inquiry-based instructional methods. When averaged, the amount of social studies IBI instruction per day in high-SES classrooms was only 4.6 minutes; for low-SES classrooms it was zero.

In total, there were three social studies IBI lessons. Two lessons occurred in one classroom and contributed 74 minutes to the total number of social studies IBI minutes. The social studies IBI lessons were the only IBI lessons in which the context of instruction included connections to life outside of the classroom. (See Chapter Two for a discussion of context in relationship to IBI characteristics.) In one classroom, the brief eight-minute lesson was a review of procedures for creating questions for interviews.

Children would eventually conduct these interviews with members of their local community and neighborhoods.

The other two social studies lessons involved a project designed to culminate an economics unit. During the first observation groups of children were engaged in finalizing a presentation to answer the question: What are the steps for making X product? Children used text-based resources provided by the teacher to describe what materials were used, where the materials originated, and what steps were included in the manufacturing process of the selected products. During the second observation the class was in the beginning stages of developing a product to sell to the school community. Six different groups of children were each asked to choose a product the class could potentially sell and then do the brainstorming or research to construct a poster presentation related to the following questions: What product could we make to sell? How is that product made? What materials or supplies are needed to make this product? How could we market this product? The teacher set the purpose for the day's lesson and then monitored discussions and facilitated decision making when necessary. Notably, the members of each group were mostly in charge of the group's decision making and ultimately the group project. Not all groups made final decisions by the end of this observation, but some examples of products being discussed included pretzels packaged with comics, buttons, posters, and popcorn balls.

The teacher later explained that each group would eventually make a product sample and deliver a presentation to the whole class. After all presentations, the class would vote to determine which product to produce and sell to the school community. The

class would also determine how to use the profits from the sale to purchase resources and supplies for the classroom.

Implementation of Inquiry Process Phases

As explained earlier, for this study inquiry-based instruction is defined as process-oriented approach to instruction characterized by a set of discrete, though sometimes recursive, phases that guide teaching and learning activities. All observed IBI lessons were coded according to the phase of the process implemented. Six different phases were observed across the 855 minutes of IBI. Time spent on each step varied and no lessons included every phase. (Phases that were present in individual IBI lessons are noted in the description of lessons in Appendix C.) Although each phase of the inquiry process was observed in both high- and low-SES classrooms, each phase was not observed in each curricular area. In all phases except analyzing, more minutes were observed in high-SES classrooms (see Figure 1, Figure 2, and Figure 3). Data collection was the most common IBI activity, followed by reporting and planning. Less time was spent questioning and analyzing data. Reflecting was the least observed of the six phases.

A chi square comparison of high- and low-SES on IBI minutes allocated to different phases in the inquiry process was statistically significant, $X^2(5) = 63.81$, $p < .001$, Cramer's $V = .273$, with high-SES classrooms devoting more time to all phases of the process except analyzing. A similar high and low comparison using the proportion of minutes per IBI step provided the same results. While there were differences in time spent in the steps, there were some qualitative similarities in the manner in which the steps were implemented. The following section elaborates on the ways steps in the inquiry process were implemented.

Descriptions of IBI Phase Implementation

The following discussion of the IBI phases is presented in an order common across many readings of the process. While the phases are described in a particular order for the purposes of this discussion, it is important to remember that the inquiry process is not strictly linear.

Questioning. The questioning phase of IBI is often described as the time spent establishing the purpose of an investigation. The purpose is often framed as a question or hypothesis. Questioning was the fourth most common inquiry phase observed across all classrooms, with 69 of all IBI minutes devoted to questioning. Of that time, more was documented in high-SES lessons (52 minutes) compared to low-SES lessons (17 minutes). While questions were noticeably missing in most science lessons (see previous discussion), more time was spent with questions in high-SES science lessons compared to low-SES.

The questioning phase of IBI was observed in two of the six language arts lessons, one high-and one low-SES classroom. Neither of the lessons that included establishing questions were integrated language arts lessons, although each engaged children in writing animal reports. Although the activity only lasted nine minutes, the most explicit questioning activity was observed during the 190-minute low-SES lesson. First, the teacher prompted children to generate questions. Then she selectively used their responses to establish categories that guided data collection during the rest of the day. The teacher restated or synthesized children's questions to create five main categories—What do monkeys look like? Where do monkeys live? What do monkeys eat? What do monkeys do? What are some interesting facts about monkeys? These questions were used

to create a large classroom chart that was revisited to sort the facts children collected during three data collection sessions.

The observed questioning activity in the high-SES classroom was similar to the one observed in the low-SES classroom, except questions did not take a prominent role in data collection. The teacher provided time for the children to independently brainstorm and record personal questions on sticky notes. These questions were posted on chart paper. In this classroom the questions were not read aloud by the children, nor were they categorized or revisited during later activities of the lesson. When the lesson progressed to collecting information about animals, the children were given graphic organizers with predetermined categories to guide the recording of facts.

Questioning was not documented during any of the integrated language arts instruction (see Table 6). Interestingly, although children were given graphic organizers to guide data collection, there was no discussion of the categories in the organizer or of the types of questions the categories represented.

Planning. In the inquiry process planning is explained as time spent determining next steps in conducting an investigation; however, it might also include planning or preparing to engage in work related to any of the inquiry phases. A total of 126 minutes of the 855 IBI minutes were spent planning. While there were more minutes spent planning in high-SES IBI lessons (93 minutes compared to 33 minutes in low-SES classrooms), this phase was implemented in similar ways across the SES groups. The planning minutes observed during this study were generally used by the teacher to provide direct instruction or to model or review steps for subsequent activities. Regardless of SES, children provided little input during this phase of inquiry. For

example, in one high-SES language arts lesson the teacher helped the children plan for data collection by modeling how to read and collect information from an internet site while children listened. Similarly, in a low-SES language arts lesson the teacher used an overhead projector to demonstrate how to record facts on a graphic organizer as she read an information book. Planning in another classroom involved preparation to write a report. In this lesson the teacher engaged the children in a discussion that recapped steps followed during a previous writing activity. This was a precursor to the children working together to write group reports. Science lessons that included planning were similar. Teachers either read or discussed steps in preparation for conducting an investigation.

Data Collection. As previously noted, regardless of SES or curricular domain, more time was spent in data collection than all other phases in the inquiry process. Nearly half of all IBI instruction—421 minutes of the 855 minutes—was devoted to data collection with more minutes observed in high SES classrooms (235 minutes compared to 186 in low SES classrooms). Data collection patterns were similar across SES classrooms—information was collected or phenomenon was observed, reported and/or recorded in some format, and shared with the teacher or class. Data collection tasks in all but one language arts lesson involved reading or listening to information and selecting specific facts to write an informational report about a chosen animal. Data collection in the other language arts class involved a guided reading group conducting a survey. After reading a book about ice-cream, this group of four children surveyed their classmates to gather information about favorite flavors of ice-cream. The plan was to create a report for the class during the next reading session.

The data collection in science lessons documented descriptions of phenomenon observed during investigations. For example, children in one low-SES classroom used a set of two mirrors to create different angles of reflection. At each angle a penny was positioned between the mirrors and children documented their observations on a worksheet formatted for the investigation. In one high-SES science lesson in which children were observing different solids, the teacher solicited observations from the class and recorded their responses on a class chart.

The data collection observed during the social studies economics lesson included some elements of brainstorming in the sense that children were making decisions about what product the group would produce and then collecting the pertinent information for making the product. This information was documented by the children on posters that would eventually be shared with the class.

Analyzing. The analysis phase of inquiry is that point in the investigation at which investigators make sense of the data collected. This phase was the second least observed phase of inquiry, with only 35 of all IBI minutes devoted to analyzing or making sense of the data. Analyzing was observed in three lessons—two low-SES lessons and one high-SES lesson. Importantly, all but six of the 35 minutes occurred during the one 190-minute language arts lesson. In that lesson, analysis involved sorting facts recorded by the children on graphic organizers. After collecting facts from each data source, the graphic organizer was cut apart and children were asked to share single facts. Working as a whole group the class analyzed each fact to categorize it based on the question it helped to answer. Facts were taped to a class chart and used later to write the report. As noted, only

two other lessons included analysis. In these two instances the teachers provided a brief statement that analyzed or explained the data while children listened.

Reporting. Reporting was the second most observed IBI step, at 178 minutes total. All but 10 minutes of reporting were documented in language arts lessons. Once again, the 190 minute low-SES language arts lesson contributed a significant number of minutes to this total (74 of 178 minutes). In general, reporting involved children in the language arts lessons writing informational texts about animals. However, in the high-SES non-integrated language arts lesson, children were asked to use the data collected from books and the internet to write a story that anthropomorphized the gorilla. In this case, the teacher's directions included giving the gorilla a name and writing the story in the first person. Children were directed to use facts to provide the setting and to describe a day in the life of their gorilla.

Thirty-four of the 78 social studies IBI minutes were devoted to reporting. Most of these minutes involved groups of children presenting oral reports to the rest of the class regarding the process of manufacturing different food products. Only 10 minutes of reporting was observed in science. That occurred in a low-SES lesson in which children shared personally composed, narrative descriptions of observed changes in plants.

Reflecting. Only 23 IBI minutes were devoted to reflecting. Reflecting was observed during two science lessons, one each in a high- and a low-SES classroom. In each case, reflecting served a different purpose. In the low-SES classroom the purpose was to activate children's prior knowledge through a review of previous science instruction. This activity took place at the beginning of the lesson and engaged children in a discussion of previous investigations regarding the properties of light. The

subsequent activity explored those properties under different conditions. In the high-SES classroom the reflection activity came at the end of the lesson with the purpose of reviewing the day's investigation and discussing new knowledge and exploring new theories. The high-SES teacher first asked the children to reflect on the day's activity—dissolving different forms of sugar in water. She then initiated the discussion by asking the children to share their thoughts about the experiment. Children's responses included some theories about the results and some ways to modify the experiment. During the discussion the teacher accepted all contributions. Ultimately, the discussion ended with no conclusions regarding the results of the investigation.

Characteristics of IBI

Five specific characteristics of IBI were examined using the IBOP activity profile scales with one of the five scales comprised of four subscales. (The categories for each characteristic are outlined in Table 3.) SES comparisons revealed notable differences in five of eight characteristics of IBI, specifically in 1) ways that responsibilities are distributed across teachers and children in lessons and in relationship to creating text-based products, and in 2) the types of discourse practices that occur during instruction. Chi square comparisons of SES indicated significant differences in 1) Roles and Responsibilities, 2) Context of Instruction, 3) Classroom Discourse Practices, 4) Composing, and 5) Recording. Chi square comparison of inquiry-based language use and time spent creating text-based products did not produce significant results, nor did a comparison of audiences for text-based products. Results for each of the IBOP activity profile characteristics is reported in more detail below.

Inquiry-related Language

IBI lessons were examined for evidence of specialized, inquiry-related vocabulary—specifically, for vocabulary that identified or named phases of the IBI process or discussions about the process. While inquiry-based vocabulary was used by teachers, discussions about the inquiry process, in general, were not observed except in one instance when a teacher discussed the scientific process as a precursor to an experiment. This may be due to the fact that observations were conducted later in the school year; teachers may be more likely to discuss the inquiry process in general earlier in the year. Although the process was reviewed, the teacher used common, less technical terms to name the phases. For example, "make a guess" was used instead of predict. That said, this discussion of the inquiry process was the only observation of this type across all classrooms using IBI. In most cases, if present, IBI related language was used only by the teacher and involved isolated uses of words like *experiment*, *research*, or *observations*. (Table 7 presents a list of vocabulary by content area.) IBI language was slightly more common in activities within science lessons regardless of SES, although some vocabulary was documented in all other domains. A chi square comparison of minutes from activities that included some mention of IBI vocabulary and the number of minutes from activities not including IBI vocabulary across groups, was not significant, $X^2(1) = 2.63$, *ns.* (See Table 8 for a distribution of minutes that included some mention of inquiry-based language across domains and SES).

Context of Instruction

The distribution of data on this characteristic precluded statistical analysis; however, examination of the raw data showed results that appear to differ substantially by SES (see Table 9). As a reminder, the context of instruction for each lesson was coded as

one of three categories: 1) the context of IBI instruction was a single curriculum, 2) the instruction included incidental connections to other curricular domains or life outside of school, 3) the instruction purposefully integrated two or more curricula or connections to life outside of school. During this study, no lessons in low-SES classrooms were observed that integrated curriculum domains and/or life outside of classroom—that is, teachers in low-SES classrooms tended to teach individual subjects. In contrast, two of the high-SES classrooms integrated curricular domains and two made connections to life outside of school. Two classrooms integrated language arts and science (see previous discussion). In all three social studies lessons—which only occurred in high-SES classrooms—children were guided in activities that would engage them with persons outside of their classroom (i.e., interviews of adults in the community and selling products to other members of the school community).

Roles and Responsibilities

The distribution of roles and responsibilities during IBI lessons was significantly different in high- and low-SES classrooms, $X^2(1, N = 855) = 104.19$, $p < .001$, Cramer's $V = .349$, with roles and responsibilities for children in high-SES classrooms more likely to include having choices or contributing to decision making during the investigations (see Table 10). Teachers in low-SES classrooms were primarily responsible for all activities. These responsibilities included delivering instruction, directing investigations, and/or managing recitation. In those classrooms, individual children were less likely to be given choices. While teachers in high-SES classrooms were more likely to offer children choices, the choices were controlled or managed. For example, in one high-SES language arts lesson, all children were expected to write one paragraph about the same animal.

However, the children were given the opportunity to choose the topic of the paragraph from four categories of information on a chart created the previous day. With respect to roles and responsibilities, the two social studies economics lessons (both in one high-SES classroom) were remarkably different than the rest. While the teacher set the parameters of the project, she also created situations in which groups of children were responsible for making critical decisions about what product each group would research, create, and eventually present to the class.

Classroom Discourse Practices

Similarly to roles and responsibilities, discourse practices in high and low SES classrooms were significantly different, [X^2 (3, N = 855) = 277.8, p < .001, Cramer's Phi = .57] with teachers in high-SES classrooms more likely to create opportunities for children to make significant contributions to discussions within activities (see Table 11). Some recitation was observed in all classrooms; however this type of verbal interaction between teachers and children was more common in low-SES classrooms. Teachers in high-SES classrooms more often used phrases or questions that were open-ended and asked children to explain their thinking or provide alternative possibilities for observed phenomena. Children had the greatest opportunities to direct discussion in the social studies economics lessons. In those lessons, groups of children were in charge and the teacher participated in conversations to provide scaffolding only when children had difficulty making decisions. She spent more time listening to the children's conversations than talking herself.

Text-based Products: Authors and Audiences

This group of scales reports first on whether or not IBI activities included the creation of text-based products. Those activities that included text-based products were further coded to describe the authorship of the product in terms of responsibility for composing text and for recording text.

Text-based products. First, there was no difference in the amount of time that children in high- and low-SES classrooms spent creating text-based products during IBI lessons. Text-based products were created in activities within 15 of 17 IBI lessons for a total of 546 minutes—294 minutes in low-SES classrooms and 252 minutes in high-SES classrooms. In total, 19 individual text-based products were created during IBI lessons—11 in high-SES classrooms and 8 in low-SES classrooms. Products included classroom charts, curriculum-based worksheets used to record data and answer questions, graphic organizers to guide data collection, and animal reports or, in the case of one classroom, an animal story. (A brief description of each product is provided in Table 12.) In some instances, as in the 190-minute language arts lesson, products were started in one activity, interrupted by a discussion activity and revisited at later point during the lesson. While there were more products, in number, created in the high-SES classrooms, more minutes were spent creating products in low-SES classrooms. This is in part due to the one 190-minute low-SES language arts lesson that spent an entire day creating a research report. A chi square comparison of high- and low-SES IBI minutes spent creating text-based products and high- and low-SES IBI minutes not creating text-based products was not significant, X^2 (1, N = 546) = 3.46, ns, Cramer's V = .015.

Composing text-based products. There was a significant association between SES and whether or not children were provided with independent opportunities to compose

text during inquiry-based instruction, with children more likely to be responsible for composing text in high-SES classrooms, X^2 (2, N = 546) = 205.26, p < .001, Cramer's Phi = .613 (see Table 13). Differences in composing responsibilities are highlighted in the manner in which high- and low-SES teachers directed the creation of animal reports. As previously explained, the teacher in charge of the 190-minute low-SES language arts lesson read informational text aloud while children listened and recorded facts. These facts were subsequently sorted and posted on a chart. When it came time to write the final report, the teacher selected certain facts from the chart, recorded them in a particular order using an overhead projector, and then children copied what the teacher had written. In contrast, a teacher in a high-SES classroom led a discussion about strategies for synthesizing information in a graphic organizer to create an informational paragraph. After this instruction, the children worked independently to write paragraphs using information from their own graphic organizer.

Recording text-based products. As with composing, there is a significant association between SES and who was responsible for recording text during IBI instruction, with children in high-SES classrooms more likely to be responsible, X^2 (2, N = 546) = 70.922, p < .001, Cramer's Phi = .360 (see Table 14). As in other instances across this study, differences in SES are complicated by the marathon language arts lesson in the low-SES classroom. In this situation the recording was heavily managed by the teacher—children were told what to copy. Because the animal report was completed in one day, a great deal of time (111 minutes) was spent with children recording—copying—text. Notably, the distribution of responsibility for recording in the other low-SES classrooms tended to give children more responsibility for independently recording

information (e.g., children independently documenting observations of plants). In all other low-SES classroom lessons, there were only 11 of 131 minutes in which children copied text. This suggests that the 190-minute lesson is responsible for the statistical significance of the chi square statistic. Similarly, in high-SES classrooms, where children were given more responsibility for composing, they were also given more responsibility for recording their own text.

Audiences for text-based products. Text-based products were coded for type of audience, whether more school based or more outside-of-school based. (See Table 2 for an explanation of categories.) Notably, regardless of SES, no audiences for text-based products observed during this study were coded as outside of the classroom. Audiences were similar across SES groups with no significant differences in a chi square comparison of groups, X^2 (1, N = 546) = 3.32, ns, Cramer's Phi = .078. The audiences for all texts reflected traditional classroom instruction. That is, texts were written for the teacher to evaluate, or texts were shared with the class or a select group of classmates. For example, most science lessons included workbook pages or worksheets that were handed in for the teacher to evaluate. Or, as in the case of the social studies economics lesson, texts were shared presentation style with the whole class. Some texts were created and used by the class and teacher as a resource during the lesson. These texts documented learning, prior learning, or sometimes enumerated the steps that would be followed during a lesson. No texts were created for audiences outside the classroom (see Table 14).

CHAPTER FIVE

Discussion

While many advocate for inquiry-based instruction, the results of this study suggest that children in second grade are experiencing little inquiry-based instruction, even in classrooms with teachers nominated because their instruction "comes the closest" to inquiry-based methods. Experiences with inquiry-based instruction that did occur took place in single lessons during the school day and not across the curriculum. Additionally, regardless of SES, the inquiry-based instruction included little attention to some phases of the inquiry process.

The SES differences observed during this study suggest that, in this case, inquiry-based instruction is implemented in ways that support social reproduction. The results of this study mirror results documented in other studies describing differences in classroom instruction by SES (Anyon, 1981; Duke, 2000). Children in high-SES classrooms had more opportunities to participate in decision-making during investigations, more choices during activities, and more opportunities to compose text. Variations in the contexts of instruction also fell along SES lines. IBI in low-SES classrooms was more frequently limited to one curricular domain; IBI in high-SES classrooms was more often integrated or connected to life outside of school. While this difference is notable, we do not know if these differences in the contexts of instruction advantage or constrain children's learning.

Conclusions

Results from this study suggest three important conclusions regarding the amount and characteristics of IBI implemented in second grade classrooms.

Children in second grade classrooms, regardless of SES, are experiencing little inquiry-based instruction and, the instruction they do experience occurs in single content areas rather than across the school day. To the degree that the findings from this study can be generalized, it appears that children may be missing opportunities to learn via a highly recommended method of instruction. While IBI methods are recommended across curricular domains, an interesting finding of this research is related to when, and in what domain, teachers implemented IBI. Rather than a method of instruction used across domains, IBI was implemented in a single content area in all classrooms in which IBI was observed. Given this finding, there is the possibility that children are learning to associate the IBI process with particular domains and, in turn, may be less likely to apply the process in situations just as appropriate, but outside of the curricular domain in which they experienced it. Because no teacher was observed using this method in more than one domain, this finding also raises questions about why teachers use inquiry-based methods in some curricular contexts and not others. What prompts teachers to use inquiry-based methods if they do? Are teachers basing their choices on methods outlined in curriculum guides? Do teachers associate the method with certain curricula or with certain types of projects or investigations? How do teachers define or describe inquiry-based instruction?

Questions about how teachers define the inquiry process also relate to how much inquiry-related language was observed. When children did experience IBI, they were rarely engaged in discussions about the process of inquiry. This, along with the limited amount of IBI related language observed for this study, may be in part due to the timing of the study (late in the school year). Regardless, this limited exposure to the language of inquiry raises concerns regarding the depth of children's knowledge about this process

for answering questions. If the key elements of the process are not named or explained, children may be engaged in doing inquiry without coming to a deeper knowledge of when and why different phases of the process are initiated. As previously stated, explanations of the process may have occurred earlier the year. If so, one might expect children would be using inquiry-based vocabulary during IBI discussions. In almost all cases, inquiry-based vocabulary was used only by the teacher.

In addition to experiencing little IBI in general, the children in this study received a minimal amount of IBI instruction across the domains specifically mandated by this state's science, language arts, and social studies standards. In fact, the amount of IBI instruction observed ranged from as little as zero minutes to 14.2 minutes per day depending upon domain and SES. The small amount of time spent in IBI raises a question about whether children are provided with sufficient opportunities to meet state expectations in each domain.

In particular, very little science IBI or social studies IBI was observed. One contributing factor may be related to the emphasis on language arts in the primary grades. Recent studies have documented that primary grade classrooms are paying less attention to science and social studies curricula, possibly as a result of the emphasis on language arts instruction prompted state and national mandates (e.g., Dolph, Goldstein, Lee, Lepori, Schneider, & Venkatesan, 2007; Saul, 2004). Like those studies, findings from this study show that the amount of language arts instruction (3992 minutes) across the 18 classrooms equaled close to three and a half times the amount of time spent in science (900 minutes) and social studies (217 minutes) instruction combined.

The lack of IBI in science is particularly surprising. Inquiry-based instructional methods are commonly associated with discussions of science education. Science educators argue for inquiry-based instruction on the grounds that it supports the development of scientific habits of mind, as well as creating appropriate contexts for learning science content (e.g., Etheredge & Ruditsky, 2003). Notably, for this study, less than half of the science instruction observed (316 of 900 minutes) used inquiry-based methods. In fact, the average amount of IBI science instruction per day equaled 8.4 minutes per day in high-SES classrooms and 9.2 minutes per day in low-SES classrooms. One would question whether this is enough time to develop the scientific habits of mind considered so important to those concerned with children's science education.

The limited amount of social studies instruction observed during this study, in general, is disconcerting. Whether inquiry-based or not, the children in this study appear to have few, if any, opportunities to learn information related to the social world. That said, a greater proportion of social studies instruction compared to science or language arts, was inquiry-based, although this comes entirely from high-SES classrooms. This may suggest that the social studies are more conducive to inquiry-based methods; however, there was so little social studies instruction observed that conclusions are tenuous at best.

A solution for increasing the amount of social studies and science in primary classrooms may be to integrate more content from those domains into language arts IBI investigations. An interesting finding in this study was just how little variation was found in the IBI language arts lessons. Given all of the topics that could be chosen for a language arts investigation, it was surprising that four classrooms in four different

districts were investigating and writing about animals. Certainly, using children's favorite themes—like animals—can be interesting and motivating for them, and also, result in successful inquiry investigations (Erickson, 2003). That said, in many cases these animal investigations did not really integrate core science content or research principles. Research has shown that integrating curriculum can have benefits for children's achievement in both domains (e.g., Cervetti, Pearson, Barber, Hiebert, & Bravo, 2007; Romance, & Vitale, 1992; Roser, & Keehn, 2002; Whitin, 2007). In that sense, developing investigations that include science and social studies content instruction in the context of language arts instruction may increase instruction in science and social studies while enhancing children's achievement both.

When implemented, IBI instruction in second grade tends to focus less on phases of inquiry that involve critical thinking and more on tasks such as the collecting and reporting of data. The phases more commonly observed during this study—data collection and reporting—are described by some as more concrete, in contrast to phases like analyzing and reflecting that require critical thinking skills and are considered more abstract (Metz, 1995). Metz argues that beliefs rooted in interpretations of Piagetian views of children's cognitive development—especially in their ability to think abstractly —have influenced visions of IBI in primary grade settings. This, in turn, has impacted the manner in which inquiry processes are introduced and presented in curricula designed for primary grade children. These views of primary grade children may influence what teachers do directly, or the curricula provided for teachers to use, or both.

Importantly, studies have shown that primary grade children are capable of engaging in complex scientific thinking including analysis and reflection (e.g., Hapgood,

Magnusson, & Palincsar; 2004; Samarapungavan, Mantzicopoulos, & Patrick, 2008). The children in this study had few opportunities to engage in this type of thinking; they spent the majority of the time observing and collecting data and little time analyzing or making sense of the data. This may have resulted in missed opportunities to teach and model critical thinking skills, as well as missed opportunities to capitalize on children's abilities for thinking. Focusing on certain phases of the inquiry process may also impact what children are learning about the inquiry process itself—what it is and how it is used. In particular reference to learning in science, Metz (1995) has argued that focusing science instruction in some phases of the inquiry process and excluding others may also lead children to inaccurate perceptions of scientific thinking as well as misconceptions of science concepts and principles.

Implementations of inquiry-based instruction vary across SES settings in ways that can contribute to social reproduction. Like other studies examining social reproduction and education, based on the findings of this study, it appeared that children in high-SES classrooms were perceived as more capable thinkers (e.g., Anyon, 1981). Specifically, children in high-SES classrooms were given more opportunities to make decisions during investigations and to provide contributions beyond answers during discussions. They were also more responsible for composing text than children in low-SES classrooms. As in some descriptions of pedagogy in high poverty urban settings, many teachers in low-SES classrooms in this study did more direct teaching or managing of recitation, provided fewer choices for children, and engaged children in copying texts rather than composing texts (e.g., Anyon, 1981; Haberman, 1991). These findings suggest that the manner in which IBI methods are implemented—like other instructional

methods observed across classrooms in studies like this one—contributes to the continuation of social class differences.

There is one way in which the results of this study did not mirror previous research studying SES differences in education. Although Duke (2000) found that children in high-SES settings had more opportunities to write for audiences outside of the classroom, there were no differences of that type observed in this study. In fact, during the IBI instruction observed in this study, no children wrote for audiences outside of the classroom. Regardless of SES, the text-based products were written with the teacher or the class as audience. Some texts, like workbook pages, served to document children's observations for the teacher to evaluate. Others, like class charts, documented observations or discussions for the class to reference during the current activity or in future lessons. In fact, contrary to some perceived benefits of IBI (e.g., Erickson, 2003; Mills, O'Keefe, & Jennings, 2004), IBI was not observed as an avenue to create more authentic text-based products in this study.

An interesting SES difference was found in the context of IBI instruction. Although not statistically tested (for reasons previously explained), SES comparisons showed that IBI instruction in low-SES classrooms included fewer connections to life outside of the classroom. We do not know if the context of instruction contributes to the social reproduction found in school settings. However, some research has shown that authentic literacy practices—practices that include texts and purposes for reading and writing texts that exist outside of school—influence adults' literacy practices outside of the classroom (Purcell-Gates, Jacobson, & Degener, 2004) and are associated with higher student growth (Purcell-Gates, Duke, & Martineau, 2007). To the degree that authentic

practices are associated with student growth, children who have more of these types of experiences—in this case children in high-SES classrooms—may be advantaged.

Limitations

There are several limitations to this study. First, focused observations document selected features or variables of classroom teaching and learning. Whether or not these variables capture all of the nuances of the targeted teaching and learning may be questioned. That said, the IBOP was the primary instrument used for data collect and is an instrument carefully designed and tested to specifically capture variations in inquiry-based instruction. One of the unique characteristics of the IBOP is the design feature that includes qualitative documentation of instruction in real time. Within that portion of the instrument, there are opportunities for the observer to describe features of the lesson that may fall outside of the categorical checklists. I also supplemented the IBOP with detailed anecdotal notes and, in some cases, asked teachers to provide explanations of observed instruction.

Second, the results of this study are based on only two days of observations—a small subset of a school year's instruction during the second half of the year. Given that the typical school year consists of about 180 days, and the assumption that teachers' instruction may vary across the school year in response to the children's learning and development, the results of this study need to be interpreted with caution. To help minimize this limitation, teachers were asked to help identify days that represented the most typical sample of their instruction. Despite those design features, the lessons observed during this study may not be representative of a teacher's instructional methods over a larger period of time. For example, nine of the teachers in this study were only

observed using IBI methods on one of the two days. Especially in the case of the 190-minute lesson, more observations might add important information about the frequency of the teacher's use of IBI instruction. Additionally, references to future work or lessons during my observations led me to believe that future lessons might include characteristics of IBI that would be coded differently. As an example, during the social studies economics lessons, I observed the children's first steps towards making and selling a product to other members of the school community. As the teacher helped children make decisions about products, she talked about advertising those products. Since the eventual consumers were outside of the classroom, those advertisements would be written for audiences outside of that classroom—parents, friends, other classrooms. All of the text-based products I observed during the study were written with only the classroom community as audience.

A further limitation is the possibility that teacher and student behavior were affected by my presence, which would be a threat to validity. Despite this limitation, observational research is one methodology that has consistently provided valuable insights into classrooms and effective instruction (e.g., Good & Brophy, 1997; Waxman, Tharp, & Hilberg, 2004). To minimize the intrusiveness of data collection I asked each teacher to provide typical instruction, to follow regular routines when introducing me to the class and to designate a space for observing that was as unobtrusive as possible.

There is also a limitation in terms of the sample of teachers in this study. Statistically, the low-SES teachers had more years of experience than the high-SES teachers. This statistic is in contrast to most descriptions of teachers in low-SES schools. According to Loeb and Beteille (in press), schools with "minority enrollments also have

higher proportions of teachers in their first three years of teaching, higher proportions of teachers with less than ten years of experience and the lowest proportion of teachers with more than twenty years of experience." This suggests that the sample of low-SES teachers is not representative, at least with respect to years of teaching. This may be due to the fact that they were nominated by principals specifically based on their implementation of IBI.

Additionally, teacher experience may be a contributing factor in the amount and characteristics of IBI observed during this study. Examination of the relationship between years of experience and the amount and domain of inquiry-based instruction reveals interesting patterns. The teachers in the four most inquiry-based classrooms had seven or fewer years of experience and three of the four implemented IBI in language arts or integrated language arts lessons (see Table 15). This included one low-SES teacher. Additionally, five of the eight teachers with 14 or more years of experience implemented IBI during science lessons. Two of the eight most experienced teachers provided no IBI and one teacher implemented IBI during an integrated language arts lesson. These patterns raise questions about the contribution of years of experience to the amount and characteristics of the IBI the teachers used. For example, are there differences in the pre-service teacher training these teachers received that might result in different implementations of IBI?

Recommendations for Future Research

This study provides important information about the amount and characteristics of inquiry-based instruction implemented in second grade classrooms. However, this is not a study of IBI implemented in a random sample of classrooms. Rather, this is a study of IBI

implemented in classrooms specifically nominated by principals (albeit of randomly selected schools in randomly selected districts) as "coming the closest" to implementing inquiry-based instruction–with two principals declining to nominate any teacher to participate in the study based on this description. Given the nature of the nomination process, it is reasonable to guess that a study of a truly random sample of teachers would have yielded far less IBI than observed in this study.

Since inquiry-based instruction has a long history and a strong presence in the literature, it is interesting that this study found little evidence of this type of instruction. While some reasons may be due to the challenges that teachers face in meeting the demands of the curriculum, some reasons may be related to difficulties related to implementing the instructional method itself. Understanding the challenges teachers face in implementing IBI and understanding how teachers who do implement a great deal of IBI introduce and sustain this type of instruction over the course of a year, would contribute important information for thinking about ways to support teachers who are inexperienced in this method.

In that respect, future work focused on inquiry-based instruction in the primary grades would benefit from studies that examine teachers' characteristics in relationship to the amount and characteristics of inquiry-based instruction implemented in classrooms. While this study describes the amount and characteristics of IBI, it does not provide information about why teachers in different SES contexts choose to implement inquiry-based instruction and in particular ways. Additionally, there is more to understand about what teachers know about inquiry-based instruction. We do not know how their

definitions and understandings of inquiry influence the manner in which they do, or do not, implement inquiry-based methods.

Results of studies showing positive impacts on children's learning combined with the results of this study—little IBI instruction is occurring in second grade classrooms—suggest that the field would benefit from research that explores what kinds of curricula and professional development might alter the amount and nature of teachers' implementations of inquiry-based instruction in different SES classrooms (Gray, 2001; Klein, Hammrich, Bloom, & Ragins, 2000; Schmidt, Gillen, Zollo & 2002; Valadez, Freve, 2002). For example, does professional development designed to provide support with inquiry-based instructional methods, combined with explanations of children's learning and development, impact the amount of instructional time spent on different phases of the inquiry process? Does professional development that supports teachers with explanations of how to integrate curricula using inquiry-based methods, along with the explanations of the benefits of integration with respect to children's achievement, increase the amount and characteristics of inquiry-based instruction teachers implement in classrooms?

This study adds important information about the amount and characteristics of inquiry-based instruction in high- and low-SES second grade classrooms. The results, which are likely disappointing for proponents of IBI, also raise concerns for content educators and those who are interested in understanding differences in educational opportunities afforded in varying SES contexts. In fact, findings from this study suggest there is much work needed to support teachers' implementation of this method of

instruction with many questions remaining to guide researchers' inquiries about inquiry in the primary grades.

APPENDIX A

Principal Nomination Guide

APPENDIX A

Teacher Nomination Guidelines

For this study I am interested in observing teachers whose methods of instruction commonly include inquiry-based teaching and learning. That is, as I define it, instruction that:

* engages children in projects or investigations,
* uses a systematic or step-by-step process,
* includes establishing questions, collecting information, and reporting answers, results and/or conclusions.

This could be inquiry-based instruction during science, social studies, the reading/writing block, or any other part of the day. I am asking you to identify the second grade teacher in your school who comes closest to providing this kind of instruction.

APPENDIX B

Inquiry-based Observation Protocol

APPENDIX B

Inquiry-based Observation Protocol

Inquiry Based Instruction
Classroom Observation Protocol

Alison K. Billman
Michigan State University
Spring 2008

CLASSROOM ID_____

OBSERVER_____

DATE_____

	OBSERVATION	☐ **FIRST**					☐ **SECOND**				
	Lesson/Session	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Lesson Topic										

CLASSROOM INSTRUCTION OBSERVATION

1. Classroom Information and Background

A. **Classroom ID #**

Observer Name (ID#)

B. **Date of Observation** _____

Time observation of instruction began: _____

Time observation of instruction ended: _____

Total observation time: (total minutes) _____

C. **Grade Level(s) of classroom** _____

Number of children per grade level _____

_____

Number of students: _____ boys _____ girls

Number of adults other than the lead teacher present during the lesson observation (e.g., education specialists, aides, parents): ☐

Identify Adult roles:

_____ ☐

_____ ☐

_____ ☐

_____ ☐

COMMENTS

Indicate percent of time adults are present during the observed lesson.
Use numbers to fill in the boxes

1= less than 20% of lesson

2= more than 20% to 40% of lesson

3= more than 40% to 60% of lesson

4= more than 60% to 80% of lesson

5= more than 80% to 100% of lesson

2. Lesson Information:

A. 1. Does the teacher state a purpose or objective for this lesson?
If yes, what is the stated purpose for this lesson? YES NO

2. Does the teacher connect the lesson to a big idea?
If yes, what is the big idea? YES NO

B. Where does this lesson appear to fit in the overall scheme of instruction? *Check which best applies.*

_____This lesson introduces a unit of study
_____Lessons came before and will come after this lesson/ This is one of a series of lessons within a unit of study or specific project that build on each other
_____This lesson culminates a larger project or unit of study
_____Other (explain)

C. Does this lesson appear to address or include any of the following content areas? *Check all that apply.*

___ Language Arts
_____ Reading
___Informational
___Literature/narrative
_____ Writing
Science
___ Health
___ Social Studies
___ Arts
___ Mathematics
_____Other (explain)

D. Does this lesson include specific instruction in any of the following content areas? *Check all that apply.*

_____ Language Arts
_____ Reading
__Informational
__Literature/narrative
_____ Writing
___ Science
___ Health
___ Social Studies
___ Arts
___ Mathematics
_____Other(explain)

Comments _____

ACTIVITY	NUMBER: CLASSROOM ID#		INQUIRY PROCESS
Record TIME	LESSON ACTIVITY SUMMARY (*Briefly describe what is happening during instruction*)	VOCABULARY T = Teacher S = Student TE = vocab. taught	A. CODE *each stage of the inquiry process as observed during the activity using Roles Rubric.*
Start Time End Time Total Min.			QUESTION; PLANNING; RESEARCH or DATA COLLECTION; ANALYZING or SYTHESIZING; REPORTING; REFLECTING; NONE
	Describe Transition		B. *CODE which stage of the inquiry process is MENTIONED during the activity with Process Lang. Rubric.*

CLASSROOM/COMMUNITY WORK PATTERNS

Check all that apply. Comment on work patterns; for example, is teacher attention equally distributed across students? Are all students participating in the activity or a select few? Are most students on task most of the time?

Students are working:	Teachers are working:	Comments
____ Independently ____ In pairs ____ In groups ____ As whole class with teacher	___ With individuals ____ Structured ____ Unstructured ___ With groups ____ Structured ____ Unstructured ___ With whole class ____ Structured ____ Unstructured ___ On unrelated tasks	

PRODUCTS ☐☐YES ☐☐NO **PERMANENT:** ☐☐YES ☐☐NO **TEXT-BASED:** ☐☐YES ☐☐NO

Check all that apply.

	Journals/notebooks		Brochures		Computer documents	Other (PLEASE EXPLAIN)		
	Classroom charts		Models		PowerPoint presentations			
	Letters		Worksheets		Web pages			
	Posters				NONE			

RESOURCES/MATERIALS *Check all that are used in the context of this lesson.*

Texts	**Experts**
___Information books ___Literature ___Pamphlets ___Encyclopedias ___Posters ___Textbooks ___Newspapers ___Charts ___Worksheets ___Letters ___ Big Books ___ **NONE** ___Other (PLEASE LIST)_____	____Present and participating in the classroom ____Communicating via e-mail or other technology ____Other(PLEASE LIST)_____ ____**NONE**
Web-based Resources ___Web-based text ___Other (please explain) _____ ___Web-based simulations ___ E-mail communications _____**NONE**	**Hands on tools and supplies**(i.e. beakers, scales, clay, seeds, etc) PLEASE LIST _____**NONE**
Hands on live materials(i.e. plants, owl pellets, live animals) PLEASE LIST _____**NONE**	

TEACHER STUDENT UTTERANCES/ACTIONS

Teacher Utterances *code and tally teacher utterances*

	Coaching/Scaffolding/Support	
	Modeling/Demonstration (think aloud; hands-on demo)	
	Telling/giving content information	
	Task structuring/Instructions	
	Open-ended questioning to probe student thinking	
	Restating or confirming student response	
	Evaluating or questioning requiring specific answer	
	Management (behavior)	
	Other:	

Student Utterances *code and tally student utterances*

	Presentation/ Report	
	Raise questions related to discussion	
	Contribute ideas to discussion	
	Monitor personal comprehension of content (i.e. I don't understand; can you say that again; etc.)	
	Clarify directions	
	Recitation (give correct answers or action)	
	Unrelated comments	
	Other:	

CODES

1	2	3	4	5	5a	5b	5c

LESSON SUMMARY Complete after observation. Provide a brief description of the lesson of the lesson.
QUESTIONS FOR THE TEACHER Note any needs for clarification or follow-up that need to be addressed in the interview.

APPENDIX C

Descriptions of IBI Lessons

APPENDIX C

Descriptions of IBI Lessons

	Content	IBI Phases	Brief Description
L1.2	LA Only	Question generating Planning for data collection Data Collection Analyze facts Report	Teacher and children generated questions and categories for collecting facts about monkeys. Teacher read different resources and children simultaneously recorded facts. Children viewed a video and simultaneously recorded facts. Teacher and children sorted facts according to categories. Teacher directed the recording of facts in the form of a five paragraph report. Children created a poster to mount the report.
L2.1	Science	(Review of inquiry process) Question provided by teacher Data Collection	Teacher reviewed phases in inquiry process and described phases in an experiment with two mirrors. Teacher provided questions and children generated predictions. Student groups conducted the

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
2L.1	Science	Analyze/Explanation	experiment and recorded and reported data. Teacher provided brief explanation for observations.
3L.1	LA Only	Question generating Data Collection (Report to be presented later)	While reading an information book about ice-cream the teacher and the guided reading group raised the question: What is the favorite flavor of ice-cream? Together they created a survey. Children dispersed through the classroom to gather data. The report was scheduled for the next guided reading session.
5L.1	Science	Planning for data collection Document set-up procedures Data Collection	Teacher explained that children would observe plant growth over time. Teacher helped children plant seeds in individual cups. Children wrote descriptions of the planting process and recorded the first observation.

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
5L.2	Science	Data Collection Report	Teacher prompted children to observe changes in plants. Children observed their plant and documented observations. Some children were given opportunities to share data with the class.
8L.1	Science	Hands-on Demonstration Data Collection	Teacher conducted a hands-on activity exploring the properties of light using a flashlight and prism. Children recorded observations as directed by the teacher.
9L.1	Science	(Review of unit activities) Hands-on demonstration Data Collection	Teacher reviewed prior unit activities and properties of light. Teacher demonstrated and made observations of an activity using mirrors, a basin of water and flashlight. Student pairs conducted the same activity and documented their observations.
1H.1	Science	(Review of unit activities) Hands-on experiment	Teacher led a discussion of the properties of a mixture. Teacher and children observed and reported properties of three different solids.

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
1H.1	Science	Data collection Analysis	The solids were combined and described. Next the solids were separated. The results were discussed to verify that the combined solids formed a mixture.
1H.2	Science	(Review of unit activities) Teacher directs data collection Hands-on experiment Data collection Reflection	Teacher reviewed the properties of solids. Teacher directed observations of granulated sugar and a sugar cube. Teacher explains steps in an experiment dissolving two forms of sugar. Student pairs conducted experiment and documented observations. After cleaning up the teacher asked the children to share their thoughts about the experiment. Some offered explanations. Some suggested ways to change the experiment. All comments were accepted and no conclusions were made.
2H.2	LA Only	Question generating	Children generated questions about endangered species and added

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
2H.2	LA Only	Planning for data collection Data collection Story writing	them to a class chart. Teacher showed an internet site about gorillas. Children independently recorded facts while watching an internet video and reading an internet website. Student pairs read books and recorded information about gorillas or monkeys. Children wrote a story about a gorilla using the collected facts. Teacher suggested that they give the gorilla a name and tell the story from the gorilla's perspective.
3H.1	Social Studies	(Question previously established) (Data previously collected) Review of report guidelines Report preparation Report	Teacher reviewed how to create a group oral report. Children worked in groups to finish preparing a report on how different products are made. Each of five student groups gave oral reports to the rest of the class.

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
3H.2	Social Studies	Review of questions Planning for data collection Data collection (Report to be presented later)	Teacher reviewed the steps in accomplishing the class project to make a product to sell to the school community including a review of key questions to guide thinking. Student groups worked together to choose and research a product to sell.
5H.1	Int. LA	(Data previously collected) Teacher modeled data synthesis Report preparation	Teacher reviewed and modeled how to use individual facts to create a paragraph. Children used data from a previously completed data organizer to write individual paragraphs. Some paragraphs were chosen for the class report.
5H.2	Int. LA	Report preparation—editing Planning for data collection	Teacher and children read and edited a class report about one wetlands animal. Teacher explained that children would work in pairs to research and then write a report about another wetland animal. Teacher provided resources to begin data collection.

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
6H.1	Social Studies	Question generating Planning for data collection (Data to be collected later) (Report to be prepared later)	The class was involved in a project to learn more about the local community by interviewing community members. Teacher led a discussion reviewing types of questions children might ask and gave directions for identifying an adult to interview. Student homework involved preparing questions for the interview.
8H.1	Int. LA	Planning for data collection Data collection (Report to be prepared later)	Teacher reviewed the process for creating an informational report and announced that children would write a report on a desert animal. Student pairs were assigned animals. Student pairs read an internet website and recorded facts about the animals in a graphic organizer.
9H.2	Science	Hands-on activity Data collection	Teacher used markers and coffee filters to direct children in a hands-on activity labeled separating mixtures of colors.

(Appendix continues)

Appendix C *(continued)*

	Content	IBI Phases	Brief Description
9H.2	Science	Planning for data collection Hands-on activity Analyze	Children documented observations. Teacher led a discussion of ways to modify the steps in the activity to possibly collect different data. Children independently explored with the materials but no documentation of observations was required at this point in the lesson. Teacher read a brief explanation from the teacher's manual.

Note. Lesson identification number indicates the number and SES designation of the classroom and the day the lesson was observed. For example, 1L.1 means Low-SES classroom one, first observation. LA Only = Language arts only; Int. LA = Integrated language arts.

APPENDIX D

Descriptions of Text-based Products

APPENDIX D

Description of Text-based Products

Products	Classroom & Observation	Description	Content
1. Class Chart	L1.2	Large chart with headings: What do monkeys eat? What do they look like? Where do they live? What do they do? Interesting facts.	LA Only
2. Data Organizer	L1.2	Single sheet organized to list individual facts—extra sheets used as necessary	LA Only
3. Report	L1.2	Teacher modeled/student copied five-paragraph report.	LA Only
4. Worksheet	L2.1	Curriculum provided worksheet formatted to record data and answer related questions.	Science
5. Data Organizer	L3.2	Teacher and student created chart to record classmates favorite ice-cream flavors	LA

(Appendix continues)

Appendix D *(continued)*

Products	Classroom & Observation	Description	Content
6. Data Organizer	L5.1 & 2	Multiple pages organized to record observations of plants—used during both lessons	Science
7. Worksheet	L8.1	Curriculum provided worksheet formatted to record data and answer related questions.	Science
8. Worksheet	L9.1	Curriculum provided worksheet formatted to record data and answer related questions.	Science
9. Class Chart	H1.2	Teacher and student created chart documenting observations of two forms of sugar.	Science
10. Worksheet	H2.1	Curriculum provided worksheet formatted to record data and answer related questions.	Science
11. Student Questions	H2.2	Student composed questions recorded on sticky-notes	LA

(Appendix continues)

Appendix D *(continued)*

Products	Classroom & Observation	Description	Content
12. Data Organizer	H2.2	Single sheet graphic organizer (one per student) with category headings: Name of animal; sketch of animal; habitat; food; height, length; weight; 3 cool facts.	LA Only
13. Story	H2.2	Using facts children wrote a story that anthropomorphized the animal.	LA Only
14. Class Chart	H3.1	Teacher and student created chart reviewing the characteristics of a good presentation.	Social Studies
15. Group Posters	H3.2	Teacher formatted poster used by children to record decisions and data	Social Studies
16. Individual Report	H5.1	Student composed paragraphs using information from a class constructed data organizer from a prior lesson.	Int. LA

(Appendix continues)

Appendix D *(continued)*

Products	Classroom & Observation	Description	Content
17. Classroom Report	H5.2	Teachers and children edited and added to existing classroom report (formatted as a book)	Int. LA
18. Data Organizer	H8.1	Single sheet graphic organizer (one per student) with category headings: description; food; habitat; interesting facts.	Int. LA
19. Worksheet	H9.2	Curriculum provided worksheet formatted to record data and answer related questions.	Science

Note: LA Only = Language arts only; Int. LA = Integrated language arts.

APPENDIX E

Tables

APPENDIX E

Tables

Table 1

School District Statistics

High SES Districts	District Configuration	Classrooms Observed	% Free Reduced Lunch [a]	% Less than High School Education [b]
District A	Neighborhood schools	1	8%	3%
District B	Early Childhood Center	2	9%	1%
District C	Neighborhood schools	2	10%	3%
District D	Early Childhood Center	2	12%	3%
District E	Neighborhood schools	2	14%	2%
Low-SES Districts				
District F	Early Childhood Center	2	64%	33%
District G	Neighborhood schools	2	66%	24%
District H	Neighborhood schools	2	66%	19%
District I	Neighborhood schools	1	67%	17%
District J	Early Childhood Center	2	73%	13%

[a] *Note.* The *2006-2007 Michigan Department of Education School Breakfast and Lunch Information* was used as a resource for the information reported for this statistic. [b] *Note.* The *2003 State of Michigan Report of Educational Attainment for District Residents 25 Years and Over* database was used as a resource for the information reported for this statistic.

Table 2

Years of Teaching Experience

Teacher	District	Years of Experience	Years Second Grade
High SES			
1H.8	A	20	18
2H.3	B	1	0
3H.4	B	1	1
4H.7	C	4	2
5H.9	C	14	7
6H.5	D	6	6
7H.6	D	9	3
8H.1	E	3	3
9H.2	E	4	4
Low-SES			
1L.1	F	7	4
2L.4	F	24	6
3L.5	G	24	15
4L.6	G	20	10
5L.2	H	18	10
6L.3	H	13	8
7L.7	I	5	4
8L.8	J	35	14
9L.9	J	32	4

Table 3

Scales and Categories for Coding the IBOP

Scales	Descriptions of Categories
Inquiry Practices	Inquiry Practices are coded as 1) present or 2) not present. The implementation of any of the following steps in the process results in a coding of present. • Questioning: determining questions that will direct further activities. • Planning: establishing procedures for another step in the inquiry process. For example, planning can include establishing procedures for setting up an experiment, for collecting data, for synthesizing data for a report, etc. • Data Collection: collecting and reporting observations. • Analysis: making sense of data collected during observations; using evidence to come to a conclusion. • Reporting: Creating a report that synthesizes observations or collected data. • Reflecting: discussing some aspect of the activity to review what is known or generate new questions.

(table continues)

Table 3 (*continued)*

Scales	Descriptions of Categories
Inquiry-based Process Language	**1.** No process related vocabulary or references to inquiry used during the activity. **2.** Inquiry and related vocabulary used or taught by the teacher. This includes discussions of the entire process or vocabulary naming steps in the process and words like experiment or research.
Roles and Responsibilities	**1.** Teacher leads; children follow. (Traditional model of instruction). **2a.** Teacher provides managed choices for children **2b.** Teacher coaches and scaffolds children's decisions, choices, and contributions.
Context of Instruction	**1.** Instruction is curriculum bound and includes only one subject or content area. **2.** Instruction includes incidental connections to other curriculum or life outside of school. **3.** Purposeful integrated instruction of two or more subjects or life outside of school. (e.g., Lesson includes direct instruction in each domain or there is a project/connection that is meaningful to the student beyond the school setting.)

(table continues)

Table 3 *(continued)*

Scales	Descriptions of Categories
Classroom Discourse Practices	**1.** Teacher delivers information or manages recitation. **2.** Teacher leads a discussion with minimal sharing or inclusion of children's ideas. **3.** Teacher and children explore and think together. There tends to be a balance between teacher and children's ideas. **4.** Children are given the responsibility to manage or lead discussions. Teacher participates as facilitator.
Text-based Products, Authors and Audiences	
Text-based Products	This scale is coded as **1)** present or **2)** not present. Text-based products are documents that include recorded language. Examples include journals, letters, worksheets, classroom charts, graphic organizers, etc. Products may not be permanent; for example, a list created on a white board is a text-based product but it is not permanent.
Composing Responsibilities	**1.** Teacher composes or manages the composing of text. Children's participation is minimal. **2.** Teacher and children jointly compose text. **3.** Children are mostly responsible for composing text.

(table continues)

Table 3 (*continued)*

Scales	Descriptions of Categories
Recording Responsibilities	**1.** Teacher records or manages the recording of text. Children's participation is minimal. **2.** Children record text with teacher coaching. **3.** Children are responsible and independently record text.
Audiences	**1.** The teacher is the only intended audience. **2.** The classroom is the only intended audience. **3.** This classroom and other classrooms or persons within the school building are the intended audience. **4.** Persons connected to the greater school community are the intended audience (e.g. administrators, parents, other schools). **5.** Persons or organizations outside of the immediate school community (e.g. pen pals, experts from industry,)

Table 4

Distribution of IBI Minutes across Classrooms

Classrooms	District	Day 1	Day 2	TOTAL IBI	Content Area
High SES					
1H.8	A	66	—	66	Integrated LA
2H.3	B	40	34	74	Social Studies
3H.4	B	—	—	—	—
4H.7	C	—	—	—	—
5H.9	C	—	62	62	Science
6H.5	D	37	54	81	Integrated LA
7H.6	D	8	—	8	Social Studies
8H.1	E	30	59	89	Science
9H.2	E	—	99	99	LA Only
High-SES minutes		181	308	489	
Low-SES					
1L.1	F	—	190	190	LA Only
2L.4	F	—	—	—	—
3L.5	G	41	25	76	Science
4L.6	G	—	—	—	—
5L.2	H	18	—	18	Science
6L.3	H	—	11	11	LA Only

(table continues)

Table 4 *(continued)*

Classrooms	District	Day 1	Day 2	TOTAL IBI	Content Area
7L.7	I	—	—	—	—
8L.8	J	28	—	28	Science
9L.9	J	53	—	53	Science
Low-SES minutes		140	226	366	
High- and low-SES minutes		321	534	855	

Note. LA Only = Language arts only; Int. LA = Integrated language arts.

W_S (N = 18) = 73.5, *ns*, r = -.25. W_S (N = 13) = 34.5, *ns*, r = -.25.

$X^2(1) = 18.46$, $p < .001$, Cramer's $V = .035$.

Table 5

Distribution of All IBI Minutes According to Domain and SES

		Science	Language Arts		Social Studies
			LA Only	Integrated LA	
Low-SES					
	Lessons	5 (4)	2 (2)	—	—
	Minutes	165	201	—	—
High-SES					
	Lessons	3 (2)	1 (1)	3 (2)	3 (2)
	Minutes	151	99	157	82
Total					
	Lessons	8	3	3	3
	Minutes	316	300	157	82

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Numbers in parentheses indicate the number of different classrooms from which the lessons came. For example, 5 (4) means five lessons from four classrooms.

Table 6

Distribution of IBI Minutes across IBI Process Phases

	IBI Process Steps					
Subject	Question	Plan	Data	Analyze	Report	Reflect
Science						
Low-SES	8	18	95	3	10	11
High SES	16	26	94	3	—	12
Science Total	24	44	189	6	10	23
	(7.6%)	(13.9%)	(59.8%)	(1.9%)	(3.2%)	(7.3%)
LA Only						
Low-SES	9	15	91	32	74	—
High SES	18	10	55	—	16	—
Integrated LA						
High SES	—	51	62	—	44	—
Language Arts	27	76	208	32	134	—
Total	(5.9%)	(16.6%)	(45.5%)	(7.0%)	29.6%)	(0%)
Social Studies						
Low-SES	—	—	—	—	—	—
High SES	18	6	24	—	34	—
Social Studies	18	6	24	—	34	—
Total	(21.9%)	(7.3%)	(29.2%)	(0%)	(20.8%)	(0%)

(Table continues)

Table 6 *(continued)*

Subject	Question	Plan	Data	Analyze	Report	Reflect
IBI Minutes	69	126	421	38	178	23
Total	(8%)	(14.7%)	(49.2%)	(4.4%)	(20.8%)	(2.6%)

Note. Data reported in minutes. LA Only = Language arts only; Int. LA = Integrated language arts. $X^2(5) = 63.81$, $p < .001$, Cramer's $V = .273$.

Table 7

Characteristics of Instruction: Inquiry-related Vocabulary

Curricular Domain	High SES	Low SES
Science	question	question
	observe, observations	observe, observations
	experiment	experiment
	test, retest	test, retest
	report	report
	data	data table
	prediction	scientific process
	investigate, investigation	
LA Only	questions	questions
	researchers, researching	research
	information	information
	facts	facts
		data
		report
		survey
Integrated LA	information	
	facts	
	data organizer	
	research	

(Table continues)

Table 7 *(continued)*

Curricular Domain	High SES	Low SES
Social Studies	questions	
	interviews	
	presentations	
	reports	

Note. LA Only = Language arts only; Int. LA = Integrated language arts.

Table 8

Characteristics of Instruction: Use of Inquiry-related Language

Inquiry-related Language		Not-present	Present
Low-SES			
	Science	20	145
	LA Only	117	84
	Integrated LA	—	—
	Social Studies	—	—
	Low-SES Total	137	229
High SES			
	Science	42	109
	LA Only	43	56
	Integrated LA	91	66
	Social Studies	34	48
	High SES Total	210	279
Total		347	508

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Data reported are minutes of activities that included some mention of IBI vocabulary. Chi square compares minutes from the activities that included some mention of IBI vocabulary and the number of minutes from activities not including IBI vocabulary across groups. $X^2(1) = 2.63$, *ns.* Cramer's $V = .056$.

Table 9

Characteristics of Instruction: Context

Context	1 Curriculum only	2 Incidental integration	3 Purposeful integration
Low-SES			
Science	124	41	—
LA Only	—	201	—
Integrated LA	—	—	—
Social Studies	—	—	—
Low-SES Total	124	242	—
High SES			
Science	151	—	—
LA Only	—	99	—
Integrated LA	—	—	157
Social Studies	—	—	82
High SES Total	151	99	239
Total	275	341	239

Note. LA Only = Language arts only; Int. LA = Integrated language arts.

Data reported in minutes.

Table 10

Characteristics of Instruction: Roles and Responsibilities

Roles & responsibilities	1	2	
	Teacher leads	A. Managed choice	B. Children lead
Low-SES			
Science	165	—	—
LA Only	123	78	—
Integrated LA	—	—	—
Social Studies	—	—	—
Low-SES Total	288	78	—
High SES			
Science	79	41	31
LA Only	92	73	—
Integrated LA	44	47	—
Social Studies	—	8	74
High SES Total	215	169	105
Total	503	247	105

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Data reported in minutes. $X^2(1, N = 855) = 104.19$, $p < .001$, Cramer's $V = .349$.

Table 11

Characteristics of Instruction: Classroom Discourse Practices

Discourse Practices	1 Teacher Direct Instruction	2 Some Children's Ideas	3 Equal Participation	4 Children Lead
Low-SES				
Science	103	44	—	18
LA Only	192	—	9	—
Integrated LA	—	—	—	—
Social Studies	—	—	—	—
Low-SES Total	295	217	9	18
High SES				
Science	9	93	43	6
LA Only	45	35	19	—
Integrated LA	61	81	—	15
Social Studies	—	8	37	37
High SES Total	115	217	99	56
Total	275	341	239	84

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Data reported in minutes. X^2 (3, N = 855) = 277.8, p < .001, Cramer's Phi = .57

Table 12

Characteristics of Instruction: Composing Text-based Products

Composing	1 Teacher Managed	2 Teacher & Children	3 Children Independently
Low-SES			
Science	82	—	20
LA Only	151	41	—
Integrated LA	—	—	—
Social Studies	—	—	—
Low-SES Total	233	41	20
High SES			
Science	—	10	41
LA Only	63	—	10
Integrated LA	—	20	71
Social Studies	—	—	37
High SES Total	63	30	159
Total	296	71	179

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Data reported in minutes. X^2 (2, N = 546) = 205.26, p < .001, Cramer's Phi = .613.

Table 13

Characteristics of Instruction: Recording Text-based Products

Recording	1 Teacher Managed	2 Teacher & Children	3 Children Independently
Low-SES			
Science	11	—	91
LA Only	121	11	60
Integrated LA	—	—	—
Social Studies	—	—	—
Low-SES Total	132	11	151
High SES			
Science	10	—	41
LA Only	20	—	73
Integrated LA	—	—	71
Social Studies	—	13	24
High SES Total	30	13	209
Total	296	71	179

Note. LA Only = Language arts only; Int. LA = Integrated language arts. Data reported in minutes.

X^2 (2, N = 546) = 70.922, $p < .001$, Cramer's Phi = .360.

Table 14

Characteristics of Instruction: Audiences

Audiences	Teacher	Classroom
Low-SES		
Science	64	38
LA Only	74	118
Integrated LA	—	—
Social Studies	—	—
Low-SES Total	138	156
High SES		
Science	28	23
LA Only	63	10
Integrated LA	47	44
Social Studies	—	37
High SES Total	138	114
Total	276	270

Note. LA Only = Language arts only; Int. LA = Integrated language arts. No instruction fitting categories 3 through 5 was observed. Data reported in minutes.

X^2 (1, N = 546) = 3.32, ns, Cramer's Phi = .078

Table 15

IBI Instruction and Teachers' Years of Experience

Classrooms	IBI Minutes	Years of Experience	SES	Content Area
1L.1	190	7	Low	LA Only
9H.2	99	4	High	LA Only
8H.1	89	3	High	Science
6H.5	81	6	High	Integrated LA
3L.5	76	24	Low	Science
2H.3	74	1	High	Social Studies
1H.8	66	20	High	Integrated LA
5H.9	62	14	High	Science
9L.9	53	32	Low	Science
8L.8	28	35	Low	Science
5L.2	18	18	Low	Science
6L.3	11	13	Low	LA Only
7H.6	8	9	High	Social Studies
3H.4	0	1	High	—
4H.7	0	4	High	—
7L.7	0	5	Low	—
4L.6	0	20	Low	—
2L.4	0	24	Low	—

Note. LA Only = Language arts only; Int. LA = Integrated language arts

APPENDIX F

Figures

APPENDIX F

Figures

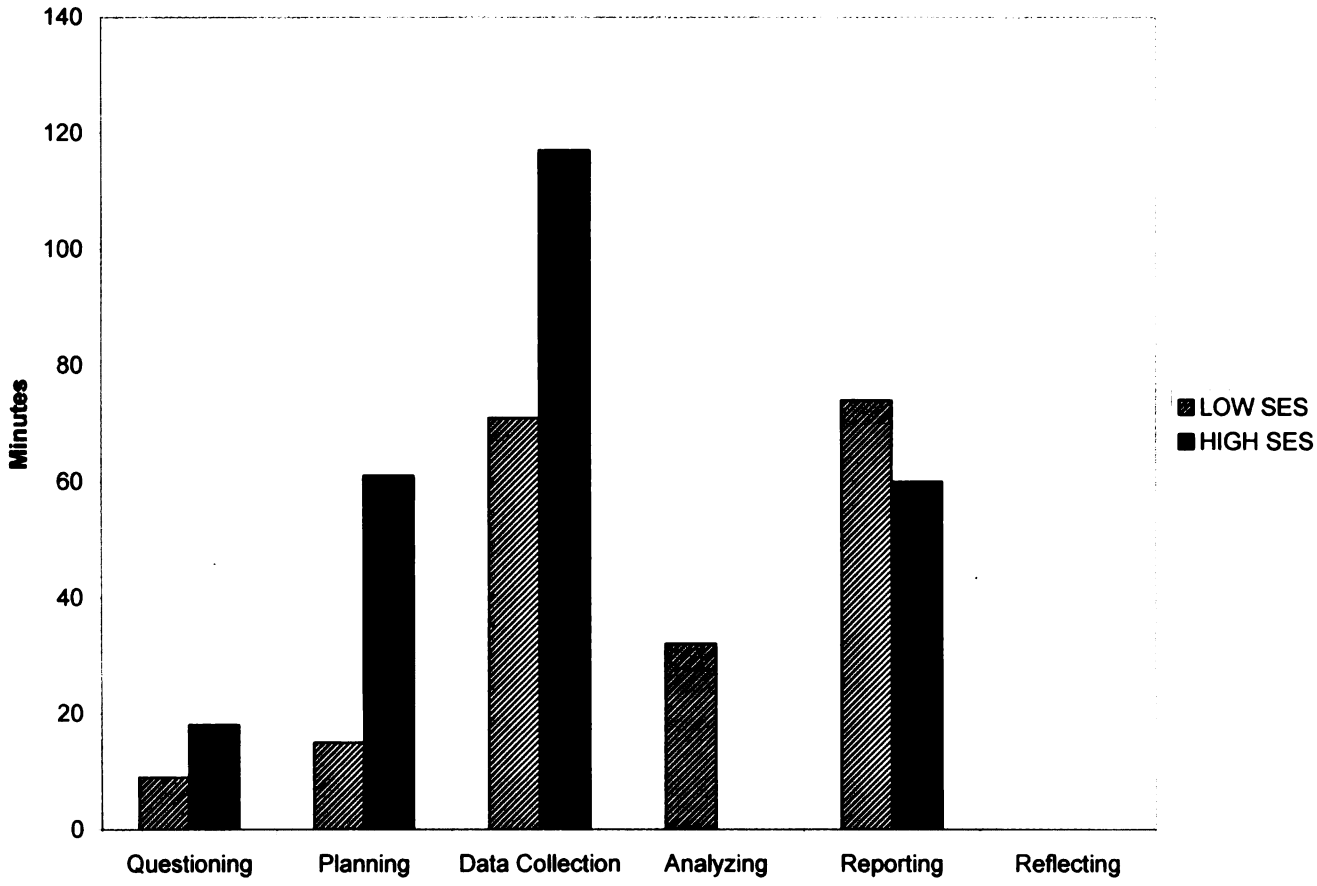

Figure 1. Distribution of all language arts IBI minutes across the phases of the inquiry process.

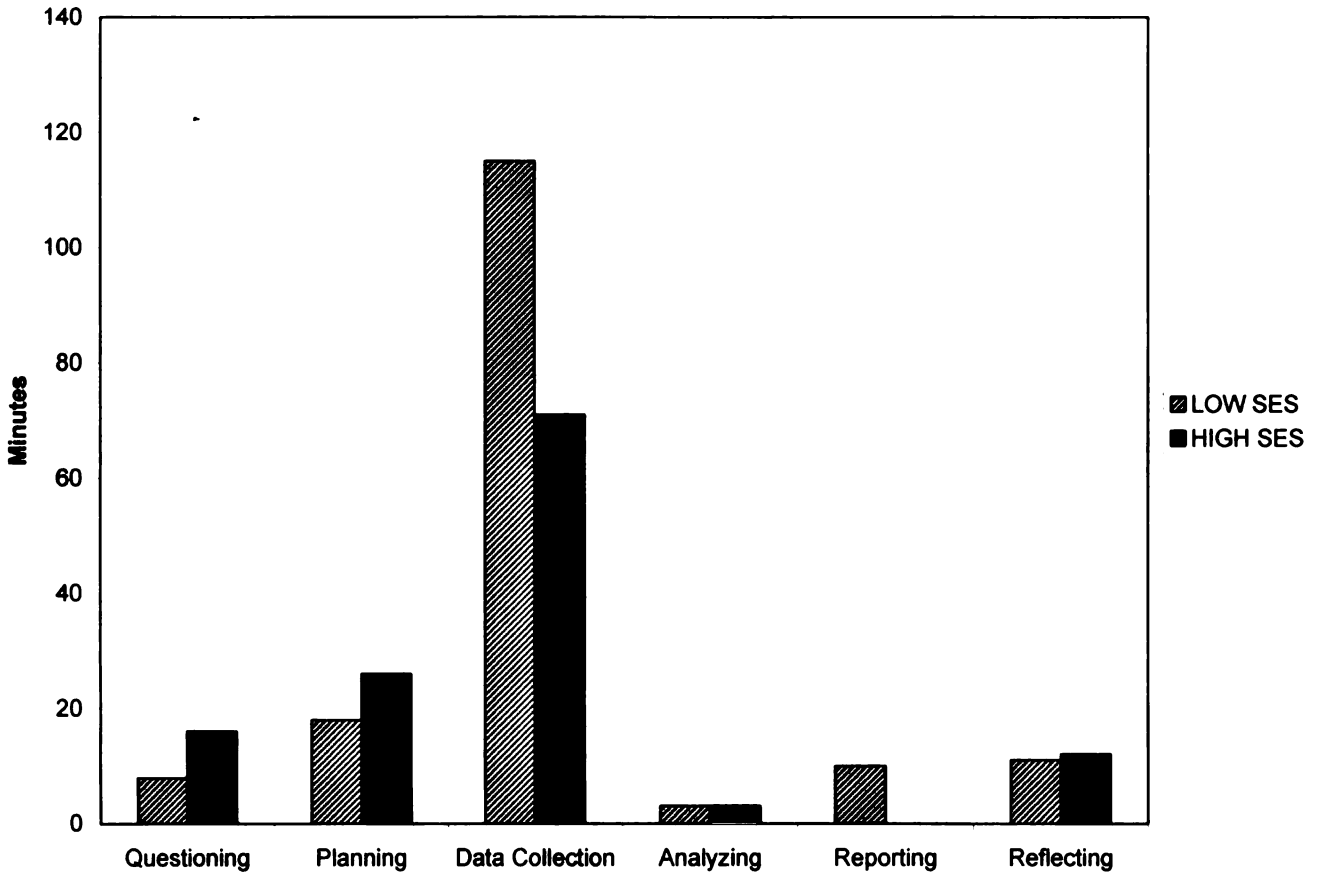

Figure 2. Distribution of science IBI minutes across the phases of the inquiry process.

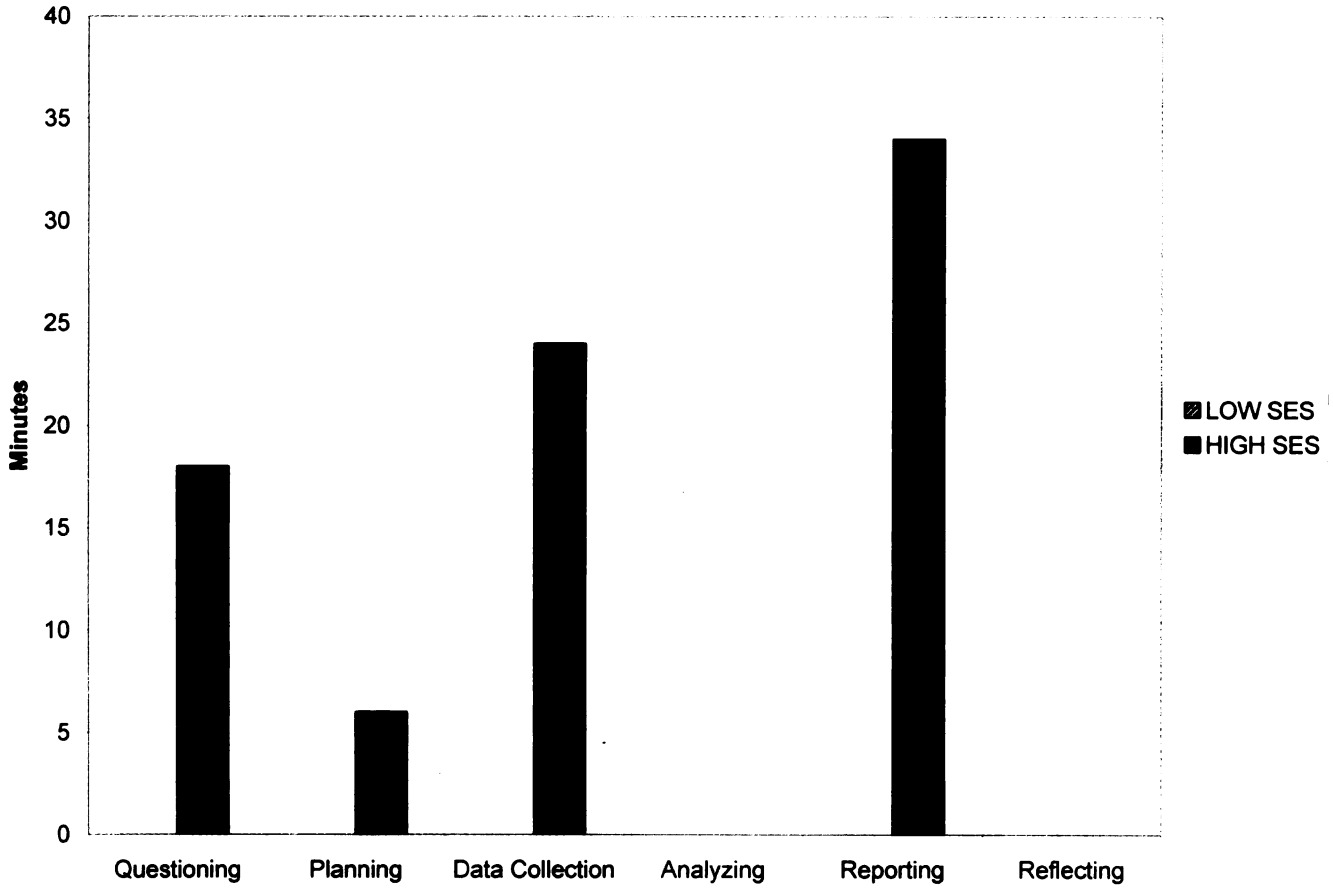

Figure 3. Distribution of social studies IBI minutes across the phases of the inquiry process.

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