HOW TEACHERS' INSTRUCTIONAL CHOICES AFFECT STUDENTS' PERCEPTIONS OF A SCIENCE CENTER FIELD TRIP: FIVE CASES
A Master's Thesis

by
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HOW TEACHERS' INSTRUCTIONAL CHOICES AFFECT STUDENTS' PERCEPTIONS OF A SCIENCE CENTER FIELD TRIP: FIVE CASES

by

MEGHAN J BRIGGS

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ABSTRACT

An abstract of the thesis of Meghan J Briggs for the Master of Science in Teaching, presented October 23, 2009.

Title: How Teachers' Instructional Choices Affect Students' Perceptions of a Science Center Field Trip: Five Cases

Teachers use field trips to science centers for a variety of reasons. Research has shown that a moderate level of structure on visits to science centers leads to the most positive learning outcomes, but little is known about how structure and instructional choices relate to their effects on students' science attitudes and other affective outcomes. This study looks at the one-day field trips of two fourth-grade and three fifth-grade classes to a free-choice science center in the Northwest. These classes were selected from a pool of classes that previously had registered to visit the science center in the fall of 2008. Interviews were conducted with the five teachers and with two boys and two girls from each class. Pre- and post-field trip questionnaires were completed by 98 students. Field notes and interview data were analyzed using grounded theory open coding. The results are presented in the form of five case studies. Qualitative data collected on the questionnaires about students' attitudes toward science was found to be statistically insignificant. The results from the case study suggest four major themes. First, students' understanding of the purpose of their field trip and the ties to the curriculum come from the clarity of communication of

goals and objectives given by the classroom teacher. Second, worksheet assignments can be used on field trips to enhance student learning without negatively affecting the students' attitudes toward their trip. Third, orientation activities and field trip follow-ups strongly influence students' perceptions of the field trip. Finally, the use of chaperones is diverse, and the different ways that teachers choose to use them can affect the students' perceptions of their trip.

This study's findings suggest that teachers should set and communicate clear field trip goals and expectations to their students, carefully consider the use of worksheets and other instructional-aids, take time to do orientation activities and follow-ups, and, finally, prepare chaperones to help them meet their field trip goals. For science centers, these results suggest that any help that can be given to assist teachers in completing the aforementioned tasks will help improve the students' opinions of their trip.

Dedication

This thesis is dedicated to my wonderfully supportive family and friends. I must especially thank my parents, who have pushed me to question the world around me and have inspired me to have confidence in my ability to uncover the answer to those resulting questions.

Acknowledgments

Many individuals and groups were integral to the completion of my thesis, and I feel it is important for me to take a moment to recognize their contributions. I would like to thank the National Science Foundation, whose funding of the Noyce Scholar program allowed me to participate in such a wonderful experience through the Center for Science Education and the Graduate School of Education. The Noyce Scholar program has allowed me to simultaneously become a researcher and educator. Each complements the other, because without a foundation in education, one cannot accurately see the questions that need to be answered, and without a background in research, one does not have the tools and experience to answer the questions that naturally arise as a teacher. This is an excellent program, and I am honored to be a member of the initial group of Noyce Scholars at Portland State University.

I would like to acknowledge the staff of the Center for Science Education, especially Dr. Bill Becker and Jennifer Wells. They are amazingly passionate and dedicated individuals whose hard work brought the Noyce Scholar program to Portland State University. These two individuals inspired me to do my best work, and I feel honored to have had the opportunity to work with them during the past two years.

I would like to thank the members of the Cary Sneider and Melissa Potter MST mentor group. Your feedback and encouragement in this project was needed and highly valued. I must also thank my thesis committee members, Dr. Cary Sneider, Dr.

Barb Ruben, Dr. Marcie Benne, and Dr. Bill Becker, whose feedback and contributions to this project were essential elements in my success.

Finally, I would like to thank the Oregon Museum of Science and Industry for its collaboration in this project, especially Dr. Marcie Benne from the Evaluation and Visitor Studies division, and Katie Keller, OMSI's Program Sales and Registration lead. I hope that this study's findings are meaningful and will help the Oregon Museum of Science and Industry continue its mission of making science relevant and exciting for all.

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CHAPTER 1: INTRODUCTION TO THE STUDY

Teachers from as far back as Aristotle and Socrates have used field trips as a tool to enhance students' learning (National Park Service, 2008). However, with increased pressure on teachers to meet a long list of standards, there is a great need for teachers to justify the time away from school. One of the most common rationales for field trips to science centers is that they will increase students' positive attitudes toward science and promote learning more about science in ways that are not commonly possible through school science classes alone. Consequently, there is a need for evidence on how teachers should structure their students' field trip experiences to maximize positive attitudes toward their field trip and toward science. This study enriches the current body of research in this area by linking the instructional techniques used by teachers on visits to science centers to the affective changes of the participating students.

OVERVIEW OF STUDY

The purpose of this study is to compare the effectiveness of alternate strategies for structuring students' visits to a free-choice science center in order to determine which methods lead to the most positive-attitude outcomes toward the field trip and toward science. The independent variable of the study will be the degree to which teachers structure the field trip experience. Structure can be viewed along a continuum from high structure to no structure. As shown in Figure 1, high structure means that students have little free choice about what they see and do at the science center. In a

low-structure condition, students have complete freedom of choice about what to do with their time.

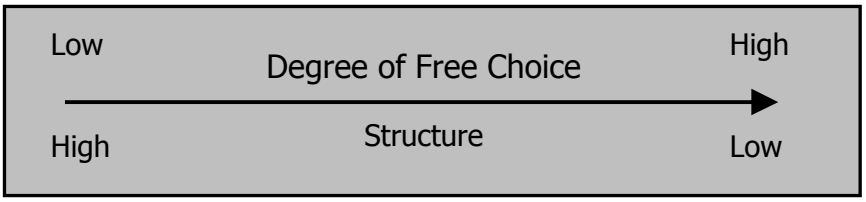

Figure 1.

The level of structure imposed by the teacher falls along a continuum and determines the degree of free choice for students.

The dependent variables for this study are students' affective changes as measured on questionnaires and interviews after the visit.

The original hypothesis for this study was that a moderate degree of structure, which ensures that students will have a common experience related to the school curriculum while allowing some free choice, would result in the most positive attitudes. The starting null hypothesis was that the degree of structure would make no difference in students' attitudes. The original alternate hypothesis was that the relationship between attitudes and levels of structure would be represented by a bell-shaped function in which the most positive-attitude outcomes for a specific visit would be seen at the mid-range of structure. This is represented in Figure 2.

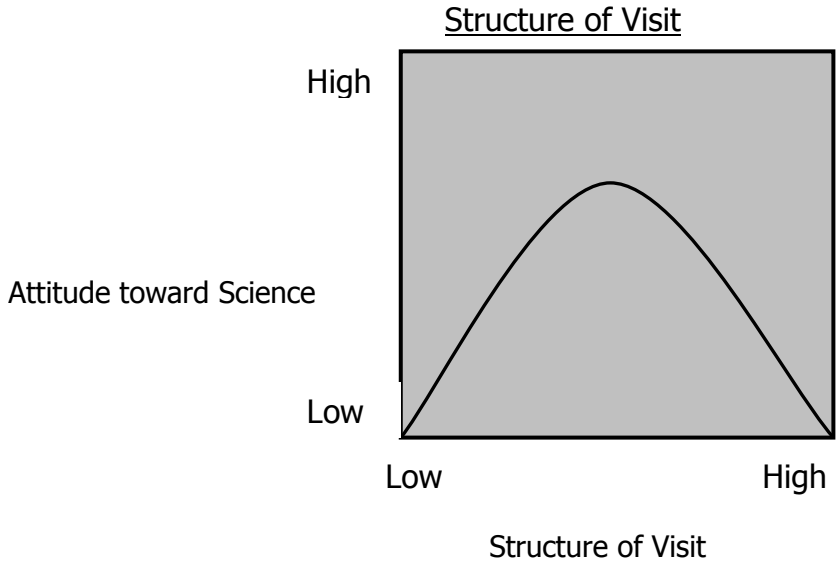

Figure 2.

This figure shows the hypothesized bell-shaped relationship between the level of structure imposed by the teacher and the students' attitudes toward science.

In order to test this hypothesis, the researcher conducted a mixed-method research study comparing two fourth-grade and three fifth-grade classes' experiences visiting the Oregon Museum of Science and Industry (OMSI). This study examined the field trip instructional practices already established by five classroom teachers. Phone interviews were conducted with the teachers in the study before they took their classes on the field trip. These pre-visit interviews helped to determine the teachers' preparation styles and field trip instructional techniques to ensure that a variety of field trip techniques were observed during the duration of the study. The teachers were asked to administer a one-page attitude pre-test survey to all of their students before the field trip. In the next phase of the study, the researcher observed the classroom

students and the classroom teacher on the field trip to better characterize the visit on the high-low structure continuum. A post-test was then given to determine the students' attitudes toward science and their visit. In the final part of the study, selected students and the teacher of each classroom were interviewed individually to discuss their experiences at the science center.

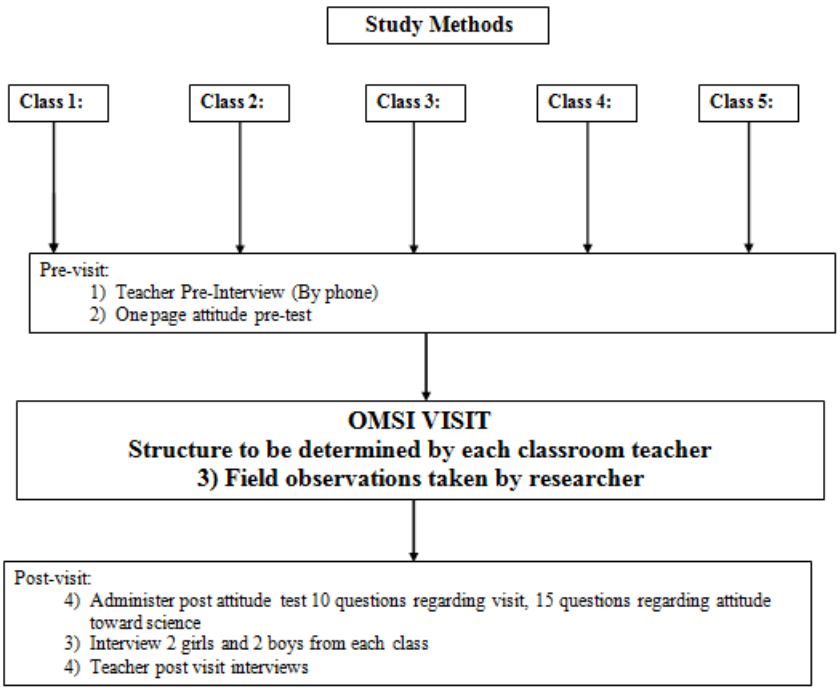

Figure 3.

This flow chart shows the sequence of steps in the study.

RATIONALE

There is a great deal of evidence in the current body of research that gives directions to teachers on how to structure field trips to improve learning outcomes, but few have investigated structure as it relates to affective outcomes. Storksdieck (2005)

found, in a case study of three environmental programs, that in order to get a more honest picture of the effectiveness of the free-choice programs, evaluators needed to broaden their view of learning outcomes to include attitude and behavioral changes in participants. The current lack of research that assesses the attitude outcomes of varied approaches used by teachers when structuring their field trips to science centers can lead to tension between classroom educators and museum educators when teachers expect museums to provide their students with facts and concepts while museum educators feel it is more important to inspire and excite kids through a free-choice experience (Price, 1991). A free-choice experience is defined here as an experience in which students' learning is completely self-directed. This study hopes to enrich the current body of knowledge by linking instructional techniques to students' attitudes. More importantly, this study will provide concrete recommendations that will allow teachers and museum educators to better meet their goals. This study's recommendations will provide enhanced understanding that will form the basis for the development of stronger partnerships between schools and museums (Price, 1991).

CHAPTER II: LITERATURE REVIEW

INTRODUCTION

Educators worldwide use field trips for a variety of reasons. They are recommended as an excellent method for helping to improve science literacy and to give students a context for personal and social learning (Tal, 2007). These ideas align with the guidelines set by the National Science Education Standards that encourage the use of both formal and informal experiences to enhance science literacy (Tal, 2007). With current funding limitations in the United States, teachers and administrators are looking for a clearer understanding of the benefits and outcomes of science field trips. It has been shown that many teachers still do not have clear goals for their field trips, but many believe that field trips help with motivation and interest in science (Mortensen, 2007). Mortensen's work gives evidence for a need to measure students' attitude outcomes resulting from visits to science centers. During the past 25 years, a great deal of research has been done in the area of informal science education. However, the research has been limited to three major areas: (a) the educational value of the visit, (b) the influence of class preparation on the visit, and (c) the factors that determine students' learning (Bamberger, 2007). Little research has been done on how science center visits influence students' attitudes toward science. The research that has come forward within the field is very exciting and shows that field trips can have long-lasting effects on attitudes toward science and can even influence career decisions (Abraham-Silver, 2006; Cosmos Foundation, 1999; Fadigan, 2004).

Research has been done to investigate the different approaches that teachers use on field trips and how those affect students' learning, but little research has been done to determine how those different approaches affect students' attitudes toward science. It has been observed that teachers use science centers in a different manner than families who visit. One question still prevalent in the research is, Does this indicate a difference in goals, or can educators learn something from the choices that families make when they visit free-choice science centers (Griffin, 1994)? Free-choice centers in this paper are defined as science centers in which the participant has the ability to direct his or her learning by deciding what to do or see while on location.

Although teachers and museum educators do not always share educational objectives and instructional means (Noel, 2007), the more we can understand about how these numerous instructional techniques influence students' learning and attitudes, the easier it will be for teachers to obtain the funds that are needed to take their students on field trips (Price, 1991). The current lack of knowledge can lead to tension between teachers and museum educators when teachers expect museums to provide their students with facts while museum educators feel it is more important to work toward higher learning skills (Price, 1991). It is hoped that this study enriches the current body of knowledge by linking instructional techniques to outcomes on students' attitudes as well as learning. Museum educators believe that it is their mission to engage, inspire, and excite kids of all ages. Alternately, many classroom educators believe that science centers are an excellent way to provide supplemental instructional science activities that will help their students learn challenging concepts.

If we find a means that will allow both groups to achieve their goals, then we can enhance understanding and the communication between museum educators and school educators. Improved communication could lead to a stronger partnership between educators at museums and schools.

Mortensen (2007) notes a common tension between museum educators who support free-choice learning and teachers who want to structure the visit to support their in-school curriculum. Well designed worksheets are proposed to bridge the gap between the two positions. However, educators must be careful in developing these guides so they do not constrain free choice to the extent that they negatively influence students' attitudes toward their visit (Griffin, 1997). It is not yet known if it also negatively influences their attitudes toward science.

Section 1: Learning Theories in Informal Education. In order to understand the best practices for museum visits, teachers and researchers in this area have turned to learning theories. One of the most popular theories in the field of informal science is the sociocultural perspective, which is the idea that there are different lenses through which we view the ways in which individuals and groups communicate and collaborate to construct knowledge, and that this is done through critical thinking and mutual meaning-making (Tal, 2007). Kisiel writes about the model presented by Falk and suggests that learning should guide museum educators. They titled their model "the contextual model," and it is composed of eight factors that help integrate context and content (Kisiel, 2003). These and other models are extremely important because

they help us understand how free-choice environments can be more authentic and accessible by many students who are not reached by traditional science teaching practices. In a review article, Braunda and Reiss (2006) articulate five ways in which out-of-classroom contexts can add to and improve the learning of science:

- Improved development and integration of concepts
- Extended and authentic practical work
- Access to rare material and to “big” science
- Attitudes to school science: stimulating further learning
- Social outcomes: collaborative work and responsibility for learning

Resnick (1988) argues that students must be repeatedly exposed to concepts in order to form new knowledge, and that informal, interactive museums can greatly influence learning. Other research shows that many museum educators and classroom teachers are resorting to formal learning theories when they plan for visits by school groups (Tal, 2007; Griffin, 1997). This is not the optimal way to use a free-choice venue, and a growing body of research has shown that one of the learning theories that works best on free-choice field trips is the constructivist view of learning (Mortensen, 2007). The constructivist theory, first presented by Jean Piaget, says that children learn best when learning is interactive. From the constructivist viewpoint, learners interact with the environment to yield a direct experience that the learner assimilates into his or her existing mental framework to make meaning. Assimilation is the most common mode of learning. When experience conflicts with their mental framework, learners must modify their internal framework to accommodate the new observations. While

accommodation is rare, it can result in profound changes in thinking, such as when students first grasp the idea. Mortensen gives the example of a student accommodating during a planetarium program—for the first time, the student realizes that the firm ground beneath their feet is really the surface of a huge ball in space (Mortensen, 2007).

All of the research on learning theory that has been done to date is important for two reasons. First, it is well understood that if students feel that what they are learning is valuable and important in their lives, they will feel more positive about their experience. Many authors incorporate fun and students' enthusiasm for a specific program into their definition of an educationally effective program (Price, 1991). Second, the understanding of learning theories helps classroom and museum educators to design effective guides and to choose the best practices for visiting a free-choice science center based on their goals.

Section 2: Teacher Preparation and Goal Setting. However teachers choose to structure their students' field trip experiences, they must have clear goals in mind when they are planning their excursions. Griffin (1997) showed that if teachers had a clearly defined purpose and an enthusiastic, positive attitude toward the day's trip, the students often reflected similar attitudes. Kisiel (2005), in a study of 86 teachers, found that teachers' goals were diverse, with there being eight main themes for teachers' motivations to lead science field trips. Kisiel points out that some of the

teachers' motivations can lead to conflict between the goals that the teacher has for the field trip and the goals that the science center has for the trip.

Noel (2007) surveyed the materials available to elementary school teachers when planning their visits to science centers. The study showed that there were very few resources provided by museums to educators. This may be because, without a clear understanding of the best framework for school visits, museums still have little guidance in creating desirable teacher resources. He also found that teachers desired short, hard-copy resources that were flexible and adaptable. Another study supported Noel's findings but also stated that there was no research-based framework for evaluating resources created by museum educators (Andrea, 2006). The three most prevalent themes in this area of field trip research currently are: the need for clear goals and the importance of using good teaching practice while at the museum (Griffin, 1994), the need to make explicit the connection between the museum experience and the classroom curriculum (Kisiel, 2006; Myers, 2004), and, finally, the importance of orienting students to the museum environment (Anderson, 1997; Bafile, 2006; Falk, Martin, and Bailing, 1978; Kisiel, 2006; Myers, 2004; Paris, 1994).

One method that has become very popular among classroom educators is the use of worksheets to help guide students while on museum field trips. A great deal of research has been done on the effects of worksheets on students' learning outcomes (Griffin, 1994; Mortensen, 2007). Many programs and teachers find worksheets to be useful in communicating goals of the trip to students as well as a way to focus observations (Price, 1991). Many in the field of museum education criticize

worksheets, saying that they inhibit true observation, which prevents students from formulating their own questions and ultimately enjoying the benefits of the free-choice experience (Price, 1991; Scribner-MacLean, 2007).

Section 3: Student Attitudes toward the Use of Worksheets. Griffin (1997) found, from a survey of 735 students in 30 classes ranging from fifth to 10th grade, that most students said they did not like worksheets because they felt that worksheets restricted what they saw and that worksheets were "boring." When asked what they would rather do, most said they would like to explore the museum without worksheets. Interestingly enough, the same group of students also felt that they were only "learning" when they were answering questions on a worksheet. Another study by Mortensen and Smart (2007) found that school groups preferred open-ended tasks and tasks that offered choice. The authors also observed that the worksheets that have been criticized are ones that "impose classroom-like constraints on the users." They claim that a well designed worksheet is centered on choice and uses the strengths of the social learning opportunities available in an informal learning venue. Yet another study, based on interviews with more than 114 children in Sydney, Australia, supported the results of Mortensen and Smart (Griffin, 1994). When interviewed, children said they didn't like the worksheets, but they also felt that without the worksheets, they wouldn't have learned anything. "They seem to identify learning almost exclusively with the type of activities which go on at school, especially pen and paper activities" (Griffin, 1994, p. 124).

Worksheets are just one method that teachers and museum educators use to structure students' experiences at science centers. Some other techniques that are often used are classes, group work, guided tours, and free-choice experience. Little is known how these varied techniques affect students' long-term attitudes toward science, but we do know that the choice of structure can have a significant effect on students' attitudes toward their visit. Flexer and Borun (1984) found that students reported the exhibits to be a much more enjoyable, interesting, and motivational experience than a classroom lesson.

Although the structured experience has been shown to be an important and helpful tool for accomplishing educational goals, some studies show the benefits of self-directed learning (Anderson, 2002). Anderson and colleagues observed the great diversity of young students' interests and learning experiences while on museum field trips (Anderson, 2002). Anderson's research supports the idea that free choice is an important quality of museum field trips. In addition, Bamberger and Tal (2007) stated that "choice opportunities and control of learning form the conditions for encouraging curiosity, interest, and motivation." The findings of their study suggest that visits structured so that they integrate some teacher guidance with student control over learning is the best means for "scaffolding" while still offering deeper engagement in the learning process. This study investigated 750 students participating in class visits at four museums, focusing on the levels of choice provided through the activity. Although their research centered on how the level of choice affects students' learning, this specific study focuses on how the level of structure affects students' learning.

Section 4: Students' Attitudes within Informal Education. Research shows that informal learning venues possess a great deal of potential to affect students' attitudes toward science (Ewing, 2004; Farmer, 2007; Pace, 2004). Price (1991) found that informal science venues lead to an enhanced interest and motivation in the area of science. They also illustrated how informal venues have the distinct ability to engage non-academic and non-English-speaking students (Price, 1991). Price (1991) observed that students are the most excited and engaged when they have the opportunity to handle materials, observe animals, or interact with other objects. A study by Pace and Tesi (2004) shows that, of those interviewed, seven out of eight adults highly valued hands-on learning and remembered those activities the most positively.

Although we currently do not know which structure leads to the most positive impacts on students' attitudes toward science, there is evidence that, in general, there are long-term effects on students' attitudes as a result of informal science field trips. One study found that a year after a visit to Great Smoky Mountains National Park, which had an emphasis on environmental education, many students remembered what they saw and heard and had developed a perceived pro-environmental attitude (Farmer, 2007). Another study found that 93 percent of young women from urban, low-income, single-parent families who participated in an informal science education program enrolled in college, and 24 percent of those students enrolled in a pre-health, science, or engineering field (Fadigan, 2004). Abraham-Silver (2006) found that, for many scientists, an experience at an informal science venue was the critical influencing factor that sparked their interest in pursuing a career in science.

The goal for many educators is to make a field trip meaningful and motivational for all students (McLoughlin, 2004). But one study by Kisiel (2007) gives evidence that teachers' perspectives toward museum visits are quite complex. It appears from the research that the best methods for preparing students are clear, and the means for obtaining the most positive learning outcomes are in the process of developing. One important piece of the puzzle that still is unknown, however, is how the different techniques affect students' attitudes toward their visit and ultimately toward science as a field of study. Further understanding in this area will help direct teachers and museum educators in the creation of materials that allow for excellent learning opportunities while inspiring students through the power of science.

LITERATURE REVIEW SUMMARY

Teachers face many hurdles when trying to adequately prepare for their trips to science centers. These hurdles include time, lack of support, the burden of administrative duties associated with the field trip, and a lack of knowledge about the best practices. Educational field trips can be excellent tools to enhance students' learning, but teachers often do not have the time or a clear understanding of how to structure a field trip, and the result is the loss of many valuable learning experiences. The hope is that this study will provide some additional information to teachers to make the task of goal setting easier. This study will make a significant contribution to the field of research by helping to inform educators about the effects of their

instructional techniques during museum field trips on the attitude outcomes of their students.

Current literature informed this study in three ways. First, it provided a framework to pose initial research questions. Second, it provided a contextual framework to help inform the research design of this study and subsequent data analysis. Finally, the review of the standing research, when integrated with the findings of this study, helped to establish future research questions within this area of study.

CHAPTER III: METHODOLOGY

INTRODUCTION

This study is a mixed methods design that used five intact classrooms from the Beaverton, Hillsboro, North Clackamas, and Portland Public school districts. Teachers were selected from a pool of teachers that booked visits to the Oregon Museum of Science and Industry (OMSI) at the time of the data collection in the fall of 2008. Classes were required to fit three study criteria. First, they needed to be a fourth- or fifth-grade class. Second, they needed to come from one of the five school districts from which the researcher had obtained approval to conduct the study. Finally, they needed to be taking their students on a field trip to OMSI that was limited to a one-day time frame.

The study was done in collaboration with OMSI groups scheduling personnel, who agreed to provide weekly printouts of the schools that scheduled visits to OMSI during the data-collection phase. These lists were reviewed weekly for teachers who fit the above three parameters for the study. Upon finding a potential subject for the study, the researcher contacted the teacher to do an initial phone interview. During the interview, the researcher explained the purpose of the study and determined the teacher's intended level of structure by asking a few questions about the activities that they would have their students do during their time at OMSI. When the teacher's activities were novel or had the potential to help create a more diverse sample of

teaching techniques, the researcher asked for permission to interview them and their students, to administer a short questionnaire, and to accompany the students on their field trip. The teacher also was asked to administer a one-page attitude pre-test to the classroom students before the field trip. The researcher also asked for a copy of any teaching resources they used during their preparation or any materials that were using during their class' visit to OMSI.

The researcher then attended the field trip, starting with the bus ride to OMSI and ending with the bus ride back to school. The beginning of the field trip will be defined as when the students stepped onto the bus, and the end of the field trip will be defined as when the students returned to school. While on the field trip, the researcher took field notes and made observations of the students. The researcher also observed the students as they arrived at school, during the time just prior to the field trip, as they returned to school, and during the time just after the field trip was completed. The activities that the teachers did to prepare their students for the field trip will be referred to in this study as orientation activities.

In the week following the field trip, the researcher returned to the classroom to administer a one-page questionnaire regarding the students' attitudes toward science and their attitudes toward their museum experience. At the same time, two boys and two girls were interviewed using a semi-structured interview process to probe for the factors that were the most important in affecting their attitudes and to help the researcher further interpret the results of the classroom questionnaire.

Study Sample

Research Participants. This study used five intact fourth- and fifth-grade classes from the Portland metro area: one fifth-grade class from Beaverton School District, one fourth- and one fifth-grade class from Hillsboro School District, one fourth-grade class from North Clackamas School District, and one fifth-grade class from Portland Public Schools. The classes ranged in size from 22 to 28 students. A total of 98 participants were provided pre-test and post-test questionnaires for the study. In four of the five classes, interviews were conducted with two boys and two girls. In one of the participating classes, only one boy and one girl could be interviewed because of unavoidable time constraints. An effort was made to select groups that were diverse in terms of gender, race, and socioeconomic background, in order to get a deeper understanding of the impact of different practices on a variety of different groups. The differences among the groups will be discussed in greater detail in the Findings section.

Human subject forms were completed for Portland State University (see appendix I), OMSI, and each of the four school districts. As an intern with OMSI, the researcher had a working relationship with the Evaluation and Visitor Studies division and with OMSI's scheduling office to make the initial contact with schoolteachers who previously had scheduled visits to OMSI.

Students participating in this study obtained parental permission as part of their general field trip permission (see appendix B), and all students were informed about

the study and signed a consent form prior to the field trip (see appendix C). Teachers in the study also signed a consent form (see appendix A).

Research Setting

Data for this study were collected in two major locations. The research questions for this study centered on the experiences of students visiting the Oregon Museum of Science and Industry (OMSI). Each class in this study visited OMSI on a one-day field trip. There, observations were made and field notes were collected. The remainder of the data was collected from the students in their classrooms.

The Science Museum. The Oregon Museum of Science and Industry is located near downtown Portland, Oregon. This museum was selected non-randomly because of its accessibility to the researcher, its reputation in the community, and its longstanding commitment to free-choice science education. The researcher developed a rapport with the science center as a volunteer and was connected with the Evaluation and Visitor Studies division by a faculty member at Portland State University. After this connection was made, the researcher was asked to become an intern with the Evaluation and Visitor Studies division. The development of the research questions, proposal, and research design was created in collaboration with the Evaluation and Visitor Studies division manager.

The mission of the Oregon Museum of Science and Industry is to make science relevant and exciting to “kids of all ages.” The museum is a scientific, educational,

and cultural resource center dedicated to improving the public's understanding of science and technology. It is an independent, nonprofit organization that serves individuals from all over Oregon and visitors from around the country. As an informal science center, the focus is on public science education rather than scholarly research or scientific collections. Most of the museum exhibits are hands-on and interactive. It has three main exhibit halls: the Earth Science and Life Science Hall; the Turbine Hall, which explores physical and chemical sciences as well as technology and engineering; and the Featured Hall, which houses the museum's temporary exhibits. The museum also has a large science store, a planetarium, an OMNIMAX Dome theater, a science library for teachers to use, and a variety of classrooms and science labs.

During the time of this study, the museum housed a traveling exhibit called *Mindbender Mansion*. This was a temporary exhibit that featured a variety of logic and math puzzles, all of which were largely hands-on and interactive. At the heart of the exhibit were the scientific tasks of problem solving and critical thinking. The exhibit also offered participants the opportunity to complete a clue card by solving a variety of selected puzzles. When the clue card was complete, the visitor could use a computer station to insert the clues. In exchange, they would receive a picture printout of themselves as members of the "Mindbender Society of puzzle-solvers."

The museum offers a wide variety of resources to schools. Teachers, when scheduling their field trips to OMSI, can select from a variety of fee-based programs, including museum admission, OMNIMAX movies, planetarium shows, submarine

tours, and lab-based classes. OMSI also offers a variety of school-based programs in which educators will visit schools for assembly-like presentations as well as smaller classroom-based activities. OMSI also provides an assortment of fee-based classes and summer programs for community members.

The museum offers a variety of resources to teachers. Along with access to their online resources, there is a reference library with materials that teachers can borrow. Before a visit to OMSI, and to aid in their planning, teachers are allowed to visit OMSI free of charge to preview the museum and ask any questions they might have.

Classrooms. The remainder of the data was collected in the study participants' respective classrooms. Pre-field trip questionnaires were sent to the teachers to administer to their students two to three days before their field trip. The researcher then made observations and field notes of the students' classroom experience as it related to their field trip on the day of the trip. The researcher then returned to the respective classrooms after the field trip to administer the post-trip questionnaires approximately two school days after the class' field trip. Interviews with the students were conducted in the hallway just outside the classroom. The school was chosen as the location of the interview for the convenience of the students, teacher, and researcher, as well as to allow for a period of time to elapse between the field trip and the interview. It also was the researcher's hope that the school was a comfortable and familiar location and would reduce some of the intimidation of responding to

interview questions, thus increasing the rapport between the researcher and the students.

Instruments and Data Sources. Quantitative data were collected using an attitude pre-test and post-test questionnaire. The pre-test was administered by the classroom teacher before the field trip, and the post-test was administered by the researcher two to three school days after the field trip. The questionnaire was designed with the goals of obtaining information about each student's attitude toward their visit to OMSI and their attitude toward science, as well as their gender, race, and English language learner background. The same questionnaire was used as the pre-test questionnaire, omitting the questions regarding the student's attitude toward their visit to OMSI. The pre-test questionnaire was a short, one-page Likert assessment with three short-response questions (see appendix G). The post-test was a two-page Likert-based questionnaire with five short-answer questions (see appendix H). This questionnaire was created using questions from Simpson and Troost's Attitude Scale (1986) and the third assessment of science by the National Assessment of Educational Progress (1977). Some of the items were constructed from Falk and Storksdieck's work on the dimensions of learning in free-choice settings (Falk and Storksdieck, 2005). This instrument was field-tested on a nonparticipating class of fifth-grade students from an elementary school in Beaverton, Oregon, to establish its reliability, validity, and age-appropriateness.

Qualitative data were gathered through interviews with teachers and students and through field notes taken the day of the field trip. In the pre-visit stage, each selected classroom teacher was interviewed using a semi-structured set of questions (see appendix E). Observations consisted of field notes taken by the researcher immediately before, during, and after the field trip to the Oregon Museum of Science and Industry (OMSI). Using a grounded theory approach, these field notes were taken to gain insight into how the field trip affects students' attitudes and to record any irregularities in the field trip, such as the bus arriving late to OMSI or a fire drill disrupting the field trip.

Two to three school days after the field trip, at the time when the class filled out the attitude questionnaire, four semi-structured individual interviews were conducted with a sample of students using a set of previously established questions (see appendix F). These interview questions were field tested before use on nonparticipating subjects. Each interview was tape recorded, then transcribed. That same day, the researcher also collected information from the classroom teacher using a semi-structured interview procedure (see appendix E).

GENERAL PROCEEDURES

DATA COLLECTION

Affective changes as a result of free-choice learning environments are very complex. Because these processes are complex, they call for thoughtful and layered research methods to more accurately assess their outcomes (Rennie, Feher, Dierking,

Falk, 2003). For this reason, this study was done as an ethnographic study in which the researcher took on the role of participant-observer to create five case studies of five classes' field trips to a local science center. To create each case study, the researcher used both quantitative data and qualitative data sources, including inductive analysis, semi-structured interviews, open coding of interviews, and questionnaires. In the pre-visit phase of the study, the classroom teachers were contacted by phone to see (through the use of a short questionnaire) if they would be suitable for the study and if they would be willing to participate. Then the researcher interviewed the classroom teacher at the school using a semi-structured interview (see appendix E). The researcher also collected a set of any resources used during the preparation for the visit as well as any worksheets or student assignments that were completed while at the museum. As this was a field study, there was no manipulation of the students into control groups, and the teachers' instructional practices were not manipulated as part of the study. The goal of this field study was to correlate the action of classroom teachers with their students' attitude outcomes.

In the next part of the study, the students were observed while on the field trip, and field notes were taken starting from when they left school on the bus until they returned to school. The participant-observer model was used as a framework for this phase of the data collection.

Participant-Observer Literature Review. Participant observation is a technique that allows the researcher to learn about the culture and experiences of a group by becoming involved in its activities (Dewalt, 2000, p. 2). This method

sometimes is called field work, but it differs from field work in that the information collected consists of explicit recordings, which are essential during the analysis phase and can be as important as data that are collected using more formal techniques. By using the participant-observer approach, the researcher can gain a fundamental understanding of the experiences of the study participants and obtain a context for later interviewing. Thus, information collected during the observations might influence the questions asked during the semi-structured interviews (Dewalt, 2000, p. 2).

The observations were narrow in scope because of the time frame of the study, and it is important to note that the observations and field notes were driven by the research questions. Although the focus of the field notes and observation was centered on the structure of the field trips and the activities and interactions of the students, the method also produced new questions that were grounded in "on-the-scene observations" (Dewalt, 2000, p. 8). The development of new research questions and hypotheses is encouraged by the participant-observer approach, and this is a large part of why this method was selected for fieldwork. This method is in line with grounded theory and helps to produce rich data and quality analysis (Dewalt, 2000; Spradley, 1980).

In the field, the researcher took on the role of "moderate participation." "In moderate participation, the researcher works to maintain a balance between an insider and an outsider" (Spradley, 1980, p. 60). While on the field trip, the observer was introduced as an outsider (a researcher) and took field notes throughout the field trip,

but the researcher also shadowed a small group on each field trip in order to look more closely at the interactions of that group throughout the day. The researcher did not play the role of the student or chaperone but did participate in the activities of the students and their group and, while on the field trip, engaged in informal dialogue with the students, parents, and teachers.

Using this model, the researcher was able to put the participants at ease and, to a degree, experience the field trip as an insider, both of which resulted in the collection of field notes that more accurately portrayed the experiences of the students and teacher. This model also allowed for flexibility, which is necessary when working with children and in an environment like a free-choice science center.

As soon as could be arranged, the researcher returned to the classroom to administer to the students a one-page Likert questionnaire about their attitudes toward science and their attitudes toward their visit to OMSI. The same day, two boys and two girls from each class were selected to be interviewed about their experience on their field trip. These interviews were conducted on a one-on-one basis using a semi-structured interview technique. The interview transcriptions were analyzed using grounded theory open coding for common themes.

Semi-Structured Interview Literature Review. Semi-structured interviews also were used to gain a deeper understanding of the experiences of the teachers and students. The semi-structured interview is a technique that allows the interviewer to gain rapport with the interviewee and gives the interviewer an opportunity to delve

deeper into areas that might require more explanation by the interviewee (Denzin, 2000, p. 656). This semi-structured technique allows the interviewer to focus the interview to ensure that the interview is helping to answer the research questions (Aberbach, 2002). In this method, the interview takes place in a formal setting, and the interviewer comes with questions that are asked of all interviewees, but the questions are not limited to a set number. For this study, the researcher asked the same set of questions to all of the students but expanded the questions when needed. For example, the researcher might ask a student, "Why did you like that so much?" or say, "Tell me more about that." At the same time, in line with the method of participant observer, the field notes and experience of the researcher also influenced the semi-structured interview. For example, "The bus was really late to come pick you up and take you to OMSI. What did you do while you waited?"

Because it is highly unlikely, if not impossible, to recreate these interviews, their reliability is somewhat low, but because the interviewees are allowed to talk openly and with some level of depth about their experiences, the validity of this technique is very high (Denzin, 2000).

Open Coding Literature Review. Open coding of interviews was used to analyze the emerging themes present in the interviews conducted with the teachers and students. This is a grounded theory approach that allows for integration of the understanding gained during observation (Dewalt, 2000, p. 173). As described by Strauss and Corbin, in grounded theory open coding, one expects patterns or themes to emerge but is unaware of what they will be (Strauss and Corbin, 2002). Open coding

of the field notes also was used as a method of analysis. To conduct open coding, the researcher reads and rereads notes and interview transcripts looking for key words or phrases that recur and explain the experiences or feelings of the participants. These become the themes that tentatively are coded. Then the researcher goes over the rest of the notes and interviews to establish the consistency of these themes throughout.

Grounded Theory Analysis Literature Review. As proposed by Corbin and Strauss (1990), grounded theory is a method of analysis that begins as soon as data are collected. The initial analysis affects the preceding data collection and influences its analysis as well. The researcher uses prior knowledge to understand their observations. The theory describes a cyclical analysis in which observations lead to analysis that helps focus future observations, which are then analyzed in more depth.

The first step in grounded theory open coding analysis is to "conceptualize" the phenomenon being observed. Thus, by labeling the phenomenon, the researcher breaks down the observations into broad and imperfect classifications. From these broad groupings, further analysis leads to more specific and accurate categories and potentially subcategories.

Grounded theory open coding can be done line by line, which might reveal a greater depth of information than other methods but is done at the cost of speed. Another method of open coding is when the researcher analyzes the data in larger chunks. These larger pieces may be sentences or whole paragraphs. When using this method, the researcher asks himself or herself what the major message or idea being conveyed is.

The power of grounded theory open coding lies in the ability to begin analysis before all data have been collected and to allow that initial analysis to inform and refine future observations (Strauss and Corbin, 1998).

DATA ANALYSIS

In analyzing the quantitative data, the researcher compared groups (each class) rather than individuals in an effort to obtain statistically significant data.

The attitude questionnaire data were entered into a Microsoft Office Excel spreadsheet. Each student received a total attitude score, which was the sum of all of their individual Likert and other questionnaire answers. The total score was compared to the total score for post-test attitude questionnaire answers. The significance level was set $p < .05$. The effect size was measured for each class in the study. Effect size is an increasingly popular method within educational research. Its use in this study will determine the size of any observed effect between the different levels of structured visits.

In the qualitative part of this study, data were collected by means of a semi-structured interview questionnaire. The interviews were transcribed, and each response was analyzed sentence-by-sentence, using a grounded theory open coding approach. The first stage of grounded theory open coding was used to identify and code the major OMSI attitude themes in each response into one or more themes as described by Creswell (2008). These larger themes were grouped in order to discover patterns that relate to the structure-free choice continuum. These emergent themes were again

analyzed to finalize a set of codes that accurately described the experiences of the students and teachers. Once a set of codes was established, the codes were applied to all interviews and field notes. In the last stage of grounded theory open coding, the codes were selected and, in some cases, combined to form the four major descriptors on the field trip:

Overall Structure Composite—This is a composite score of the number of times that the teacher referenced pre-visit orientation activities, follow-up activities, ties to curriculum or standards, and his or her goals and expectations. These themes were determined to be important aspects of field trip structure based on previous research.

Expectations—This is a composite score of the teacher's articulation during interviews or on the field trip of their expectations and objectives for the field trip.

Field Trip Challenges or Hurdles—This score represents the number of times that a teacher spoke of challenges in planning or implementing the field trip.

Average Student Field Trip Score—This score is a composite of the positive experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student. These scores were then averaged to give the class' average student field trip score. See Figure 4 for an example of this analysis.

Ms. Swank Field Trip Analysis	
Overall Structure Composite	22
Expectations	17
Field Trip Challenges or Hurdles	1
Average Student Field Trip Score	4

Figure 4.

Example of qualitative analysis.

Reliability and Validity. Multiple measures were taken to ensure reliability and validity of emerging themes discovered in this research. First, triangulation of multiple data sources, including observations, questionnaires, interviews, and researcher field notes, was completed to compare and confirm descriptions and the reflections of the teachers' experiences to those of the students. Secondly, that data were analyzed in an effort to discover any negative cases that challenged initial observations and interpretations.

CHAPTER IV. FINDINGS

Section 1: Qualitative Findings

Field Trip Case Studies

In this section, five case studies are presented. Following the case studies, the quantitative findings are presented and discussed. The case studies are presented from most structured to least structured as determined by the coding of the teacher interviews and field notes. Each case study is organized in chronological order and is broken down into five subsections. These subsections are: orientation to the school, students, and teacher; field trip preparation; day of the field trip; field trip follow-up; and conclusion. Coding marks appear in the interview excerpts used within this section; see appendix I for this study's codebook.

A. Ms. Tinder Case Study

Orientation to the School, Students, and Teacher

Ms. Tinder's fifth-grade class attended OMSI for a one-day field trip on October 3, 2008. The makeup of this particular class is diverse. Ms. Tinder's class is part of an immersion program in which the students are fully immersed in the Spanish language for half of the day and spend the remainder of the day completing their studies and conversing in English. Approximately 50 percent of the class speaks English as their first language, and the remaining 50 percent speak Spanish as their

primary language. The students in this class come from very different economic backgrounds and diverse family groupings.

Ms. Tinder is a very vibrant and passionate teacher. She said that she felt her students are excited about science in general. She spoke of the fact that she felt there is not enough time to teach it because of the pressures of state testing and the emphasis on reading and math. Her philosophy about teaching science is that you need to give students a great deal of hands-on experience, and they need to be invested in the learning process. She feels that students need to understand why it's important for them to learn the science that they are being taught.

Field Trip Preparation

Ms. Tinder did a variety of field trip orientation activities with her students. First she explained to the students that they would be collecting facts on the planet they selected to research as part of the space unit. Her explicit instructions were that they would be incorporating the facts that they collected at the museum into their planet projects. She also went over how the Clue Card, the activity that would be done in the logic puzzle exhibit, would work and how to use it.

> Ms. Tinder: "I made copies of the clue card and showed it to the students and went over how it worked, how you have to solve the puzzles and then find the clues and put them into the computer [T, C-pre]."

Ms. Tinder, in comparison with the other teachers in this study, spent a great deal of time and effort preparing for the field trip. She visited the museum and took time to think about how she would schedule the day. She also spent time doing the activities that she would be asking her students to do.

> Ms. Tinder: "I went to OMSI two days prior, and I did the puzzles and got the answers and saw the other areas and decided that because those were permanent [exhibits], I would take them to the [*Mindbender Mansion* exhibit] first and then if they had time, they could see the others [C-pre, T]. And then I tried to figure out if five kids could work at the chemistry or physics labs, and it was not too many kids. They have way more than five stations."

She also made schedules for the parent chaperones so that her plans for the day were clearly communicated to parents.

> Ms. Tinder: "…and I made the schedule so all the parents had a copy of the schedule, which gives them some independence so when they are done with the *Mindbender*, they actually have the choice to take their kids to a different area [T, E]."

Along with these printed schedules, she also communicated directly to the students before and during the field trip about their schedule and how she expected them to spend their time.

Day of the Field Trip

On the day of the field trip, Ms. Tinder arrived early to put the finishing touches on her parent information packets and the students' name tags, as well as to take care of any other administrative details that needed to be completed. In the parent packets, she provided her chaperones with the day's schedule, the names of the students in their group, the answers to the museum's puzzle exhibit, and emergency contact phone numbers.

At 8:30 a.m., students began arriving and settling in for the day. Ms. Tinder instructed them to get their lunches from the cafeteria and to place them in the bin. Once all of the students had arrived, she briefly went over some behavioral expectations in Spanish, and the class headed out to the street, where they would be taking the public bus system to the science center.

The students and parents waited patiently in the drizzly rain until the bus arrived. When the bus arrived, all of the students were able to fit onto the same bus, but many were required to stand. The students rode politely on the bus for approximately half an hour before they arrived at OMSI. During this time, students continued to chat and socialize, but no observable discussion specifically related to the field trip was heard. The students arrived at the museum about 9:30 a.m. They were greeted by a museum volunteer who went over the museum's rules and expectations and the lunchtime procedure.

The group was scheduled for a planetarium show, but before they saw the show, Ms. Tinder gathered the students together and spoke to them as a group to ask

them how they wanted to spend the time between the movie and lunch. “From 10:45 to noon, do you want to spend all your time in the *Mindbender Mansion*, or do you want to see other parts of the museum?” The response from the kids was a nearly unanimous vote for *Mindbender Mansion*. Ms. Tinder responded that she thought that was a good idea because there was a lot to see there. This is an example of one of the ways that Ms. Tinder communicated her expectations to students while still taking into consideration their input. This time of action gives the students more choice and a feeling of control over the day. During the interviews with students from her class, all four students felt that they got to see and do what they wanted while at the museum, and this request for input from the students might have been a factor in such a positive response when they were asked to give their feelings of control while on the field trip.

After Ms. Tinder addressed the students, there still were 15 minutes remaining before the planetarium show began. As the kids waited in the lobby, about half of them stood in line to take part in an exhibit that allowed them to compare their weight on Earth to their weight on other planets. Other students freely perused a few other space-related exhibits in the area outside the planetarium. It was observed that the students seemed to gravitate toward things that they could touch or move.

Before entering the planetarium, students were reminded by their teacher to look for three facts about the planet that they were studying at school. It was noted that although they were reminded to listen for facts about their planet, the students did not take notes during the movie or have any structured way to remember the facts that they heard.

As students exited the theater, there was no noticeable talk about the scientific content of the movie, but some students were amazed by the strange physical experience of watching a movie on a large dome screen.

The students then separated into their small groups and met up with their chaperones for the time remaining before lunch. These small groups where assigned by Ms. Tinder and consisted of four to five students and one adult chaperone. From 10:45 a.m. to noon, all of the students in the class explored the *Mindbender Mansion* exhibit. The individuals in each group stayed in close proximity to each other, but students were free to choose puzzles and exhibits that interested them. This exhibit was designed to be very tactile and engaging. Students often were engrossed in a puzzle for 10 to 15 minutes. Some students were observed to become quickly frustrated and to move on to the next puzzle or challenge. The social interactions among the different groups in the exhibit were observed to be very diverse. Although students were divided by their teacher into small groups, some students interacted with other groups. Along with the interaction among groups, some students appeared to prefer working on the puzzles alone. Some students were very focused on completing the exhibit's clue card. This clue card had a set of puzzles listed on it that could be found throughout the exhibit. When the puzzles were solved, the students received a clue, and when put together, those clues gave a code word that could unlock a computer simulation, and the student would get their picture taken as a "master clue detective." Ms. Tinder offered a prize to students who completed the clue card. During the exhibit exploration, it was observed that some students were working on the card

while others were not completing it at all. Some students were completing the clue card together, working on the same puzzles together, while other students were observed copying answers from their classmates. Gradually, during the exhibit time, the structure of the groups became more relaxed. Toward the end of the hour and a half, students appeared to be in pairs and no longer in their small groups.

From noon to 12:30 p.m., students and chaperones collected in the Turbine Hall to have lunch. They ate their sack lunches and rested. No observable talk about their experiences that day was heard during this time.

After lunch, groups dispersed to different parts of the museum to explore areas they had not yet seen. In the chemistry lab, students could choose which of the six different experiments they would like to conduct. Detailed directions guided students through each of the hands-on experiments. The instructions appeared to be well written, because students were observed to be very independent, but when students stumbled or were confused, museum instructors were available to help.

Students also enjoyed the ball room. The ball room is a contained room where visitors can explore and engineer different machines that will move the balls throughout the room. Students were observed actively engaging in problem solving and engineering activities.

At 1:50 p.m., all of Ms. Tinder's small groups met just outside the museum and headed to catch the public bus back to school. Two students misplaced their coats in the museum, and Ms. Tinder had to make the executive decision to leave the coats

because she did not want to risk missing the bus. This period of gathering the students and departing from the museum was filled with a bit of stress and anxiety.

Field Trip Follow-Up

Upon arrival back at school, the students were asked to do their regular journal writing. Some of the writing suggestions were to write about the museum experience, the rain, or the vice-presidential debate. Later that week, students completed presentation posters on the planet of their choice, incorporating the facts that they had been asked to collect at OMSI during the field trip.

Analysis

Coding and analysis of Ms. Tinder's field trip and the interviews conducted after the field trip revealed that, of the teachers surveyed in this study, her field trip was the most highly structured. She also was found to have very high expectations for the field trip and for her students.

Ms. Tinder Field Trip Analysis	
Overall Structure Composite	27
Expectations	18
Field Trip Challenges or Hurdles	1
Student Field Trip Experience Score	5

Table 1.

This table shows the analysis results for Ms. Tinder's elements of structure and the number of times that she talked about or communicated field trip expectations to her students. This data comes from the coding of field notes and teacher interviews. The table also shows the average number of times that students who were interviewed referenced experiences of fun and enjoyment in conjunction with their field trip. The chart also shows the average student field trip score, which is a composite of the positive experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student.

Orientation. Orientation activities appear to have had a strong influence on the students' fun and enjoyment of the field trip. When the interviews of Ms. Tinder's students were coded, they revealed that not only did her group have the highest occurrences of fun and enjoyment, the activities to which Ms. Tinder took the time to pre-orient the students also were frequently mentioned as being highly enjoyable. Three out of four students mentioned activities that Ms. Tinder pre-oriented them to when asked, "What did you get to do at the museum that you really wanted to do?"

> Student A: "…the mind mansion. We were there for hours. I really like the carts, and I got to do that, and it was fun [FE]."

> Student B: "The *Mindbender Mansion*. I never knew that the mind quizzes were there, and I've never seen that room, and it was really cool to go in there…[FE]."

There appears to be a strong correlation between the pre-visit orientation activities and the activities that the students remembered and enjoyed.

Schedule. Of the four students interviewed, all of them talked about following the schedule, and they spoke very highly of their experiences at the museum. In an excerpt from one student interview, we see how this student speaks of the schedule and the teacher's expectations.

> Student: "She really wanted us to go to the mind mansion, and then we could do whatever we wanted, and then we went to the planetarium show [E, S].
>
> Researcher: "What did you think of these activities?"
>
> Student: "They were really fun. I like them a lot [FE]."

This excerpt shows that the student not only was aware of the schedule but also felt that it allowed for some level of choice and control over the day's activities, and that his or her overall impression of the activities planned by Ms. Tinder was very positive.

Free Choice. During the interviews with students from Ms. Tinder's class, all four students said that they got to see and do what they wanted while at the museum. Ms. Tinder's request for input from the students might have been a factor in such a positive response by the students when they were asked about their feelings of control while on the field trip.

Connection to Classroom. The first thing that was evident about Ms. Tinder's field trip to the science center was that she had very clear ideas about how the trip was connected to her classroom curriculum and how the field trip helped her to meet state benchmarks.

> Ms. Tinder: "[The field trip] ties right into the Earth, moon, and stars [curriculum] with the planetarium, and the logic puzzles prepares them for the state test. Right now they don't know this, but a lot of things they saw in the Turbine Hall are going to be reinforced with a science kit we call variables. The kit is pretty experimental, so I'm hoping when I do teach it, that the kids will think back to what they saw and did at OMSI [ST, CB]. Also, at the end of the year I teach sex ed, so I know that will tie into some of the stuff they saw in the Life Science Hall [ST, CB]."

Ms. Tinder also made the ties to the curriculum explicit by having the students do an activity on the field trip that tied the trip to their space unit. While on the field trip, students were instructed to find three facts about the planet that they had chosen to study. In her interview, Ms. Tinder asserted that "because they had questions about something specific when they went in, they got more out of it [E]."

From the interviews of students in Ms. Tinder's class, we see that her thoughtful attention to how the field trip would connect to the classroom curriculum and state standards helped students to understand the purpose of the field trip. Three out of the four students interviewed were able to articulate reasons their teacher wanted them to go to OMSI that closely aligned with the reasons given by Ms. Tinder.

One student made reference to the connection between the field trip and the space unit, and the other two mentioned the logic puzzle exhibit.

> Student 1, “I think because the teacher wanted us to know more about planets, because we are doing our report on planets.”
>
> Student 2, “I think we went to OMSI ’cause she wanted us to actually think harder when you are doing really challenging things and work harder.”

The combination of the field trip activities appears to have led to a greater understanding of the field trip’s purpose and its role in the class’ curriculum.

Conclusion

Ms. Tinder’s case study shows the following strong elements:

- She took time to prepare by visiting the field trip site and envisioning how her students would interact with the various exhibits and programs. She then made careful plans.
- She developed clear goals and expectations for her students.
- She oriented the students and chaperones about why they were going and what they were supposed to do on the field trip.
- She chose a schedule that provided some direction to explore certain exhibits and learn certain things but also allowed for free choice.
- She was able to clearly articulate all of the above prior to and during the field trip.

B. Ms. Swank Case Study

Orientation to School, Students, and the Teacher

Ms. Swank's fourth-grade class attended OMSI on an all-day field trip on November 13, 2008. Ms. Swank's class is part of an inner-city, Title I school in which about 65 percent of the students participate in the federal free and reduced lunch program. One-third of Ms. Swank's students receive special education services. This larger ratio of special education to general education students compared to district averages is because of Ms. Swank's expertise and training in this area. Ms. Swank shared that she felt that her students had very positive attitudes toward science largely because of the fact that the school-wide curriculum is very hands-on.

Field Trip Preparation

The class' field trip was jointly planned between the school's two fourth-grade teachers as the culminating event of their study of the states of matter. As part of their planning and preparation, the chaperones were carefully selected, and the teachers wrote an open-ended scavenger hunt for students to complete during their time at OMSI. The scavenger hunt asked students to list on the corresponding page examples of solids, liquids, and gases. They also were asked to explain in writing where these states of matter were observed.

Leading up to the field trip, Ms. Swank did several things to prepare and orient her students.

> Ms. Swank: "I like to set the stage pretty early, so about a week and a half [prior], I talked about what OMSI looks like and why we are going [C-pre, O]. I set up expectations by talking about what it would look like for a fourth-grader going to OMSI [E]. Talked about OMSI's labs and gave them some examples, so they would get excited beforehand [C-pre]. I sat them down and went over expectations the day before. [I wanted them to give] complete sentences and [I went over] what the directions were, in context, and how they discovered evidence of solids, liquids, and gases [O]."

Ms. Swank oriented her students to the physical space of the museum by giving them descriptions of the exhibits and laboratories that they would be seeing. She also prepared her students by going over her expectations multiple times and explaining what it would look like for a fourth-grader going to OMSI. We see this when she asks them what a fourth-grader at OMSI looks like in comparison with a first-grader.

Day of the Field Trip

On the day of the field trip, Ms. Swank arrived at 8 a.m. For the next 15 minutes before students arrived, Ms. Swank spent time organizing and preparing for the day. She conversed with the other fourth-grade teacher about the medical needs of one of their students; they needed to insure that someone who was attending the field trip was trained to attend to his needs.

As the students arrived, Ms. Swank asked them to get out their lunches and set them on their desks so she could get a count of how many lunches she needed to get from the cafeteria. When all of the students were seated, she addressed them as a

group, going over behavioral expectations and reviewing the worksheet that they would be completing at OMSI.

> Ms. Swank: “Let’s talk about what it will look like at OMSI. I’ve been to OMSI with kids 13 times, and I’ve been with first-graders where they just run around and don’t really look like I would want them to. How do fourth-graders look at OMSI? If you can’t stay with your group, then you will be with me, and you will get to read a book and re-do your science packet—yes, the one that you already did.”

She then went over the worksheet with kids, and she checked for understanding from the parent volunteers. Ms. Swank: “The kids will be doing a scavenger hunt. I’ve said this before, but a scavenger hunt in fourth grade looks different in fourth grade than in first grade. What we want to see is higher-order thinking and fully engaging with the exhibits. I don’t want to see random button-pushing. There is a tendency to ‘fly.’ [Speaking to the class] If you’ve learned something by the time you’ve gone home, then you’ve gotten out of it what I’ve wanted. I want complete sentences and location of matter example. [Speaking to the parents] When they are done, they don’t need to have all of it fully filled out, because that says that they didn’t get a chance to experience OMSI and play, but I want it to at least be half-filled out.”

Ms. Swank then went over the schedule with the class and informed the parents where and when they would be meeting to board the buses home. She announced the groups and dismissed the students to use the restroom and head to the front of the school to meet the bus.

As the students rode to OMSI, they spoke on a diverse range of topics—everything from horseback riding and scary movies to what they want to be when they grow up. It was not until they crossed the bridge and OMSI came into view that the conversation turned to excitement about their upcoming museum visit.

When the bus arrived at OMSI, the students were greeted by a volunteer. They briefly went over the day's schedule and OMSI's rules. The students then emptied off the bus, worksheets in hand, and dispersed in their small groups as assigned by Ms. Swank. These groups consisted of approximately four or five students and one adult chaperone. As the students moved through the exhibits, it was observed that Ms. Swank was moving from one group to the next, checking in with students and parents on their progress with the assignment.

The students' groups did not have any prescribed itinerary for their museum visit, so the small groups decided independently of the larger group where they wanted to spend their time. One of Ms. Swank's groups was observed spending the first hour in the Life Science Hall. The students under observation did not read the exhibit and moved excitedly from one exhibit to another. The worksheet did slow them down at times, and they did debate and engage in scientific thinking when trying to decide which page an item would go on. One boy was fascinated by the snakes in the Life Science Lab, but he had a hard time deciding if it was a solid, liquid, or gas. When he spoke with his classmates, they talked about how it had solid skin and vertebra but that it also would have blood, which is a liquid.

After an hour, the students decided as a group to move down to the featured exhibit, *Mindbender Mansion*. In this area of the museum, the students in the group under observation moved freely, exploring many exhibits and puzzles. Seldom were they observed solving puzzles, and they were easily frustrated. The students did not appear to slow down and read unless the chaperone read to them or asked questions to purposely slow them down.

After half an hour in this exhibit, Ms. Swank stopped the group and encouraged the students and chaperone to go to the physical labs located in another part of the museum.

In the chemistry lab, students in the group being observed went right to work on the various experiments being offered. They quietly worked independently, following the directions for the scripted lab experiments. The students appeared to be able to follow the instructions and do the experiments independently, but OMSI employees and volunteers were there to guide them when needed.

One student in the group completed the scripted lab experiment, then asked if he could do another one. He then proceeded to change the variables and the combination of chemicals in the experiment and commented on the results. Overall, students were very engaged in this area of the exhibit and, in contrast to their behavior earlier, proceeded in a more focused manner while still remaining fully engaged and appearing to enjoy the activities greatly.

For the remaining 15 minutes before lunch, the group under observation explored the museum's ball room. As explained previously, this is a contained room

where visitors can explore and engineer different machines that will move the balls throughout the room. The students were very focused and engaged and were reluctant to leave when they were told it was lunchtime.

As with the other field trips, no discussion or talk was heard at lunch about the students' experiences that day or any connections to their classroom learning.

From 12:25 p.m. to 12:50 p.m., students in the group being observed for the day explored the Turbine Hall and the Physics Lab. The students were particularly excited by the large Van de Graaff generator. They were engaged and actively questioning the phenomenon that they were experiencing.

By 12:55 p.m., students were back on the buses and were preparing for their return to school. As the bus departed OMSI, a great deal of discussion and comments about the day's field trip could be heard. The following are a few excerpts:

> Student 1: "I want to come here again."
>
> Parent and Student 2: "So the more pulleys, the easier it is to lift more weight. With no pulleys you have to lift the whole weight yourself."
>
> Student 3: "Cool! There's going to be a wild oceans movie. Oh, mummies!" [Comment about signs for upcoming movies.]
>
> Student 4: "That was awesome."
>
> Student 5: "I want to see the submarine."

After a few minutes, talk of OMSI and the day's field trip ceased, and it turned to normal fourth-grade conversation. At 1:40 p.m., the bus returned to school, and the students went back to their classroom.

Field Trip Follow-Up

After returning from the field trip, scavenger hunt sheets were turned in, and Ms. Swank handed out 3-by-5 note cards for an OMSI reflection. She asked students to put one feeling sentence, one interesting fact sentence, and one interesting experience sentence. Students were instructed to write their name at the top of the card. She then drew an example on the board. Ten minutes were spent on this reflection, then the students went out for a recess break before continuing with other class work. A couple of days after the field trip, they went over the graded states of matter assignment. These activities helped students see that their trip was meaningful and was tied to their curriculum.

Analysis

Coding and analysis of Ms. Swank's field trip and the interviews conducted after the field trip revealed that, of the teachers surveyed in this study, her field trip was the second-most highly structured, and she was found to have very high expectations of the field trip and for her students.

Ms. Swank Field Trip Analysis	
Overall Structure Composite	22
Expectations	17
Field Trip Challenges or Hurdles	1
Average Student Field Trip Score	4

Table 2:

This table shows the analysis results for Ms. Swank's elements of structure and the number of times that she talked about or communicated field trip expectations to her students. It also shows the number of challenges faced by Ms. Swank in conducting her field trip to the science center. This data comes from the coding of field notes and teacher interviews. The chart also shows the average student field trip score, which is a composite of the positive experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student.

Use of Chaperones. Ms. Swank used her parent chaperones to help create a more structured field trip experience for her students. The manner in which she used parent volunteers was novel in comparison with the other teachers in this study, and it helped her to accomplish her expectations and goals. Parent volunteers were intentionally selected by Ms. Swank to ensure that they were capable of fulfilling the duties asked of them. Once the parent volunteers were selected, Ms. Swank sent home a letter explaining what would happen on the field trip and her expectations of them and the students. In the letter, she explained the states of matter scavenger hunt that the students would be completing. When the parents were in the room with the students on the day of the field trip, she again explained the directions for the scavenger hunt, gave her expectations for the field trip, and confirmed that the parents

and the students understood. When interviewed, Ms. Swank explained that this use of parents to accomplish the activities that she wanted to do on the field trip was one of her largest goals.

> Ms. Swank: "I was curious as to whether or not parent volunteers would help to structure an environment where students were not just running from activity to activity and instead engaging in things [G]. From my own experience and from what I saw of the experiences of the kids, it seemed like they were [K]. They were, with their scavenger hunt, looking for examples of solids, liquids, and gases [K]. I think a way higher percentage of kids used the labs this year because of scaffolding for parents. They knew of my expectations, and the kids know of my expectations. They did it, and they met the expectations [O, E]."

We see in this excerpt that not only did Ms. Swank have very clear expectations for the field trip and for her student's behavior, she also communicated those expectations very clearly to her students and to the parent volunteers. This attention to the role of parent volunteers resulted in a sustained effort by the parents to keep the students on track, which in turn resulted in the students completing the assignment and engaging with the exhibits in a way that was not seen on any other field trip in this study.

Teacher Preparation and Goal Setting. Ms. Swank was very thoughtful and intentional in the way she prepared for her day at the science center. She worked with her team of fourth-grade teachers at her school to make the instructional decisions and plans for their day. As a group of teachers, they visited the science center during an educators' night offered by OMSI. That night, they toured the museum and found what the museum had to offer. They had planned to do a very specific, content-based

scavenger hunt, but as the day of the field trip neared, they decided as a group that it would be better to keep the assignment more general and open ended. In the following excerpt, Ms. Swank explains why she and her team made these changes to their original assignment.

> Ms. Swank: "I wanted them to be able to float, touch, and experience. We had scheduled teachers to go and write a specific scavenger hunt with content questions [G]. Then we thought about it and realized that it would take some of the joy out of seeing the museum, so we changed what we did and made it a little more general while keeping high expectations, but it allowed for some diversity in how the kids answered it. It also made it less stressful for the parents who couldn't find the yellow ball that you want the kids to write something about [T, G]. So I think they were able to experience more of the museum at the museum because it wasn't such a specific scavenger hunt."

This quote helps us understand that not only was Ms. Swank concerned for the learning outcomes of her students, she also wanted them to have a positive experience and to have the freedom to see the parts of the museum that they desired.

Although Ms. Swank was new to the fourth grade and not that comfortable teaching science, she spoke of her experience as a summer camp program leader, as which she planned and executed many field trips. This experience might have been a big contributing factor to her success at establishing and communicating clear objectives and expectations to her students and parents and at following other best practices for successful field trips as established through previous research in this area.

Field Trip Expectations. Like Ms. Tinder, Ms. Swank communicated her academic and behavioral expectations to her students very clearly. We also see from

the student interviews that, just as Ms. Tinder's students did, Ms. Swank's students had a relatively clear understanding of the purpose of their field trip. Three out of the four students interviewed gave responses that matched the goals and purposes articulated by their teacher.

> Student 1: "She thought it would be [a] good [way] to end the science unit [O]."
>
> Student 2: "So that we could learn a little more about matter and about science because OMSI has a lot of cool things about science that you can learn, and you aren't sitting in the class [A, L, FE]."
>
> Student 4: "I think we went because we were doing lots of solids, liquids, and gases and because our teacher might have wanted us to learn about solids, liquids, and gases [O, CB]."

All three of these students understood that their field trip was connected to their science unit on states of matter. Two of these three students also articulated their understanding that their teacher wanted them to continue and extend their learning on the topic of study.

Enjoyment Linked to Learning. The most interesting facet of the students' interviews, and an aspect that was unique to Ms. Swank, is that not only did students have positive feelings toward their visit to the science center, these positive feelings also were strongly linked to their experiences of feeling like they were learning the content that their teacher wanted them to learn. The following are the four students' responses to the question, "Did you enjoy your trip to OMSI?"

> Student 1: “I would have liked more time to enjoy the museum, but I had some fun doing this wild goose hunt for all these types of matters [CC, S, D].”
>
> Student 2: “Yes, well—a little bit. We went to one place for a few minutes, and I just found something really interesting to write about, and then we had to go and I didn’t have enough time to write because all the other kids wanted to go somewhere else [D, GSE]. I liked it because they had that new room, the mystery puzzle room. I like the spelling game [FE].”
>
> Student 3: “It was fun because you didn’t just get to look at it, you got to learn about it. You got to write about it [L, E].”
>
> Student 4: “I enjoyed when I was at the science stuff like the mansion when I saw lots of science stuff [FE]. I felt I was learning more about animals and more about gases, liquids, and solids, and I learned about animals and wrote about it on my worksheet [L].”

Students 1 and 2 enjoyed the field trip and doing the worksheet, but they spoke of being somewhat constrained by the assignment. All four students linked their enjoyment during the field trip to the worksheet and to the feeling that they were learning.

> Student 1: “I liked learning [L] about the rocket. … You had to pump in the water and air or it wouldn’t go anywhere. And … last time I went there, it went so high and had so much water in it, it got us wet. I just wanted to go there again [FE].”
>
> Student 2 (as quoted before): “So that we could learn a little more about matter and about science because OMSI has a lot of cool things about science that you can learn, and you aren’t sitting in the class [A, L, FE].”
>
> Student 3: “I am happy that we went to OMSI and that people got to learn. I felt that I learned about the things that she showed you, the games all about

> science and you had to spell out the word and then you got it right, and I learned a lot from there [L, FE]."
>
> Student 4 (as quoted before): "I enjoyed when I was at the science [exhibits] like the mansion when I saw lots of science stuff [FE]. I felt I was learning more about animals and more about gases, liquids, and solids, and I learned about animals and wrote about it on my worksheet [L]."

These excerpts from the student interviews illustrate the specific language that students used when speaking about their enjoyment at OMSI. While students in other classes spoke of experiences during which they most likely were learning, none of them linked their learning and enjoyment as explicitly as Ms. Swank's students. Finally, of the groups observed in this study, Ms. Swank's group had the most observable discussion about OMSI during their trip back to school. These types of comments were atypical and show a level of integration of concepts and excitement about their trip that was not seen in any other group in this study.

Conclusion

Ms. Swank's case study shows the following strong elements:

- Her students appeared to have a very enjoyable time on the field trip and clearly understood the purpose of the field trip.
- The students' enjoyment of the field trip appears to be strongly linked to their feelings about what they were learning. Ms. Swank drew upon her previous experience in planning field trips to execute a field trip that followed many of the best practices in the current body of research.

- Ms. Swank did a variety of things to prepare herself for the field trip, including the construction of an assignment for students.
- Ms. Swank developed goals and expectations for the field trip. She also communicated those goals and expectations prior to and during the field trip.
- She oriented the students and chaperones about why they were going and what they were supposed to do on the field trip.
- Her students understood the role that the field trip played in their science curriculum.
- She used parent volunteers effectively to structure a field trip environment that was conducive to learning.

C. Ms. Ping Case Study

Orientation to School, Students, and the Teacher

Ms. Ping's fifth-grade class attended OMSI on November 4, 2008. The class' makeup is unique within this study because one-third of her students (eight out of 24) are identified as TAG (talented and gifted) students. The school's neighborhood is upper middle class, but 16 percent of the school's population participates in the federal free and reduced lunch program. Most of Ms. Ping's students are white; approximately one-fifth of the students are non-white. According to Ms. Ping, her students' overall attitude toward science is very positive, and they have had positive experiences with science. Ms. Ping said during her interview that her students started this year with a

great deal of scientific content knowledge, at times even surpassing her own knowledge.

Field Trip Preparation

This field trip was planned as part of a space unit. To prepare for the field trip, Ms. Ping visited OMSI during an educators' night. There she found out information about the museum and registration procedures. After deciding to visit OMSI with her class, she used the science center's online resources to select a planetarium show for her students and to learn more about the museum. To prepare her students, she taught the content of the space unit and did several orientation activities on the day of the field trip.

Day of the Field Trip

On the day of the field trip, students arrived at 8 a.m. to start the day. Ms. Ping had a set of orientation activities planned for her students, but those plans were derailed when she had to spend the first 30 minutes scrambling to rearrange groups because of the short-notice cancellations by three parent volunteers. While Ms. Ping scrambled to reassign groups, she asked students to write on a piece of notebook paper their predictions of things they thought they would see on their field trip that day. After about 15 minutes of work on this activity, many students lost focus and began to socialize. Some students approached their teacher with questions and concerns about

the group that they would be in. She calmly responded to the students with the statement that, “Groups are continuously changing.”

About 8:30 a.m., Ms. Ping sent a group of students to pick up a set of school lunches. A few minutes later, Ms. Ping collected students on the carpet area in front of her rocking chair. She asked them a variety of orienting questions and gave some behavioral expectations for the day. The following is a short excerpt from this discussion:

> Teacher: “How many kids have been to OMSI?”
> (Approximately half of the students raised their hands.)
> Teacher: “How many kids have been to a planetarium show?”
> (About six students raised their hands.)
> Teacher: “How many of you have had lunch in the Turbine Hall?”
> (Five or six students raised their hands.)
> Teacher: “How many kids have been to the *Mindbender Mansion*?”
> (None of the students raised their hands.)
> Teacher: “I really encourage you to try the puzzles. Sometime you might feel you are reaching the point of frustration. You might give up, but keep at it. … It is your job to stay with the parent volunteers you are assigned to. If you get separated, what should you do?”
> (Students gave a variety of good answers.)

After a few more behavioral expectations were given, the student groups were announced, and the students left so they could use the bathroom, then walk to the school bus with their chaperones. Each group consisted of approximately five students and a parent chaperone.

On the school bus, many students remained quiet and calm, some students continued to socialize amongst themselves, while others sang. No observable talk

about OMSI was heard until the students crossed the bridge to the east side of the city. From the bridge, the familiar OMSI building could be seen, and there were excited shouts of, “I can see OMSI,” and, “I can see the submarine.”

When the class arrived at the museum at 9:15 a.m., a volunteer came onto the bus to welcome the group and to go over the museum’s rules and expectations.

As the group waited in the lobby area for the planetarium show, students explored the exhibits about space. Unlike Ms. Tinder’s class, this group’s main attraction was the “Gravitron,” a large marble works exhibit that demonstrates the principles of simple machines. A large group fixedly watched as the large metal marbles moved throughout the machine. At 9:30 a.m., the group lined up for the planetarium show. The show was called *Passport to the Universe*, and it took the students on a virtual tour of the universe.

As the students exited the planetarium, a parent volunteer asked them what they thought of the show. Some of the responses were as follows:

– “Good.”
– “Kinda scary.”
– “It felt really, really, weird.”
– “I understood most of it, but some of it, I didn’t understand.”
– “I never had so much fun with science.”

After leaving the planetarium show, the groups were free to explore whatever section of the museum they liked for the hour before lunch. Students in one particular group met outside the planetarium show to discuss where they wanted to go. Each student had a different section of the museum that they wanted to see. This group

decided that they would go to the Life Science Hall, which two of the five students wanted to see first. Then they would move on to the featured exhibit, the *Mindbender Mansion* puzzle exhibit, after which they would see how much time they had remaining. The students in this group went together to the Life Science Hall. In the hall, they stayed together in a loosely dispersed group. They went very quickly from one exhibit to another with little focus. They were not observed reading anything, and if they did not understand something within the first few seconds, they quickly moved on to the next thing. There was a real sense of urgency and rushing within this group of students. Despite the rushing, this group ended up spending the whole hour before the lunch break in the museum's Life Science Hall.

At lunch, groups sat together and ate quietly. The students talked amongst themselves, but no discernable talk about the museum or their experiences that day was observed.

After the lunch break, the same group of students was observed. The pattern from the morning continued. The students in the group would decide what they wanted to see quickly by coming to a consensus that was mediated by the adult chaperone, and then the group would move to that area of the museum. They again moved quickly from one exhibit to another, stopping to read something only when they were prompted by their parent volunteer. Despite their rushed style of exploration, the group showed much enthusiasm and energy for each exhibit. After lunch, the group's first destination was *Mindbender Mansion*, but the exhibit did not

seem to hold their attention, and they quickly moved on to the Turbine Hall, where they spent the rest of their time.

The student groups collected at 1:15 p.m. to board the school bus for their trip back to school. On the bus, a few students were observed talking about their experiences with the Van de Graaff machine.

> Student: “I liked that thing that made my hair go up.”
> Parent (smiling): “Oh, you liked that, did you?”

While on the bus, when Ms. Ping asked one of the chaperones about their experience that day at the museum, they replied, “Yeah, it went good. It was hard to keep track of the boys sometimes. It was hard to get them out of the ball room.”

Students on the bus appeared to be very tired and quiet. The classroom teacher and chaperones were observed to be talking about upcoming ballot measures. No other noticeable talk of OMSI was observed on the bus ride back to school.

Field Trip Follow-Up

Back at school, Ms. Ping again collected her students onto the carpet and asked them what their “aha moments” were. Some of the things that students shared were: an experience building a bridge out of large foam pieces, a soundproof room where they could test their hearing, an exhibit where you could use a thermal radiation camera to detect heat and cold, a swing exhibit that was linked to a motion detector and had a digital imaging computer display that showed the wave motion created by the swing,

and finally a simulated earthquake exhibit where they could stand in a house and experience a simulated earthquake. She then instructed the students to return to their seats and write in their journals about their "aha moment" and also to reflect on their prediction.

The following day, they reviewed and discussed their journal entries and the field trip. In her interview, Ms. Ping said that she would have liked to have done more post-trip activities, but that because of the placement of the field trip at the end of the space unit, the follow-up activities didn't fit well into her instructional plans.

Analysis

Coding and analysis of Ms. Ping's field trip and the interviews conducted after the field trip revealed that, of the teachers surveyed in this study, her field trip was the most moderately structured, with relatively high levels of communicated expectations. When Ms. Ping's interviews and field notes were coded, they were the highest of the five field trips for challenges or hurdles.

Ms. Ping's Field Trip Analysis	
Overall Structure Composite	16
Expectations	13
Field Trip Challenges or Hurdles	7
Average Student Field Trip Score	4

Table 3.

This table shows the analysis results for Ms. Ping's elements of structure and the number of times that she talked about or communicated field trip expectations to her students. The chart also shows the number of times she spoke about challenges or hurdles in the planning or implementation of her field trip. This data comes from the coding of field notes and teacher interviews. The chart also shows the average student field trip score, which is a composite of the positive

> experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student.

Orientation and Follow-Up. Ms. Ping used both museum-orientation activities and post-trip connection activities to help her students get the most out of the field trip. Ms. Ping did three things to orient her students before the field trip. First, she allowed them to self-select the groups that they would be in at the museum. Next, she had them write predictions in their journals about what they would see or do when they went to the museum. Finally, she led a classroom discussion about the upcoming field trip. This classroom discussion before the field trip worked in several ways to orient the students. During the discussion, students were asked to draw upon any previous experience at OMSI, they were allowed to ask any questions they might have had about the upcoming field trip, and Ms. Ping was able to set behavioral expectations. It was clear from Ms. Ping's interview that she saw the value in these pre-visit orientation activities. She even expressed an intent to have done more of them, but the morning of her field trip got cut short because she had to spend time rearranging groups due to the absence of three scheduled chaperones.

> Ms. Ping: "My original plan was to really talk about the different exhibits that were there and have them make a plan for what they were going to see first, second, etc. [UP]. I would [have told] them 'these are some of the things that are available for you to see at OMSI' and kind of given them a summary of the exhibits, and as a group, do some planning of the top things they wanted to see and [create] a plan [UP]."

The events that Ms. Ping did and the ones that she intended to do have been shown in the research to increase students' learning and their comfort while on the field trip.

Connection to the Classroom. Ms. Ping's field trip was strongly tied to her curriculum. She planned the field trip to correspond to her space unit. Because this group has a large percentage of kids who are identified as "talented and gifted" (TAG), Ms. Ping also spoke about how the logic puzzle exhibit was important in meeting their needs. She said, "For those TAG kids, [the exhibit] stretched their brains and made them think through those particular problems [G]."

Field Trip Expectations. Beyond the planetarium show, Ms. Ping did not have her students complete any assignments or give them any specific requirements for their time at OMSI. She also did not speak to the students about why they were going to OMSI. Although, as we can see from the coding of the interviews and field notes, Ms. Ping did have a relatively high level of expectations, most of those centered around behavior. Neither of the two students interviewed was able to give clear reasons for their field trip that aligned with the goals discussed by Ms. Ping during her teacher interview. Their responses were vague and do not include any reference to the space unit they recently completed.

> Student 1: "Well, one, we were picked, my teacher said in a lottery or a raffle, and we are in the right grade level and, I'm pretty sure, as you can tell, we all love science [A]."

> Student 2: “Maybe to learn some new stuff or to learn some new projects. I think we went to OMSI to get ready for and see some ideas for December [science] projects [O].”

Student 1 had the misconception that they were selected to go to OMSI based on a lottery system, and while her teacher knows that they love science, this fact does not match the reason given by their teacher for their trip to OMSI. In Student 2’s response, he discussed upcoming science projects. Again, these might have been discussed in class, but they were not the explicit reason for the trip to OMSI.

Enjoyment Linked to Interactive, Hands-On Exhibits. When asked to speak about what they remembered, both of the students who were interviewed spoke vividly of their memories. Ms. Ping’s students gave responses about their experiences with interactive, hands-on exhibits. In their interviews, neither of the students spoke of the planetarium show, which was the one required activity. The following excerpt was Student 2’s response to the question: “What do you remember about your visit to OMSI?”

> Student 2: “I remember [where] you put water in the bottle and air and you push the button. … I remember the ball room. [We] used the air and it made the ball come out. In the ball room, I remember another thing that makes the ball go around. The puzzle room was awesome. I remember the carts, and we won against the girls [FE]. And I remember the thing where you were trying to get the ball in the hole, and I remember the spelling game [FE].”

We see that in each of Student 2’s memories, he used action verbs such as “push,” “used,” “won,” and “get.” It also is clear that his memories of the trip are positive ones.

Conclusion

Ms. Ping's case study shows several strengths of her field trip instructional techniques:

- Her field trip was thoughtfully integrated and aligned with her classroom curriculum.
- She spent time orienting her students to the museum and, when the students returned, they did follow-up activities to connect and reflect upon their experiences.
- Ms. Ping scheduled a day that allowed for free-choice exploration of the exhibit, which the students viewed highly favorably, according to their interviews.

Ms. Ping's case study also shows a few weaknesses of her field trip instructional techniques:

- It appears that Ms. Ping's lack of clearly communicated academic expectations might have contributed to the inability of the students interviewed to articulate the reasons that their class went to OMSI.
- The students did not have a clear understanding of the reason for their trip or how the trip connected to classroom learning. It must be noted that this did not take away from the positive experiences of the students. It can be speculated that Ms. Ping's instructional strengths, clear behavioral expectations, orienting procedures, and reflection activities might have had the effect of compensating for her lack of clearly communicated goals and structured learning activities.

D. Ms. Stull Case Study

Orientation to School, Students, and the Teacher

Ms. Stull's fifth-grade class attended a field trip to OMSI on November 10, 2008. The school is located in a suburban community that is mostly middle class. About one-third of the students are English language learners, and one-third of them participate in the federal free and reduced lunch program. When asked about her students' range of attitudes toward science, she referred to the challenges her students face in reading nonfiction text. She said that with their recent topic of the solar system, the students had the opportunity to experience a wide range of activities with a greater emphasis on hands-on activities. Because of these challenges in reading the nonfiction texts that they use for their science curriculum, she asserts that there is a wide spectrum of attitudes that range from boredom with the text to enthusiasm and curiosity.

Field Trip Preparation

This field trip was the end-of-unit event for Ms. Stull's space unit of study and was jointly planned by the fifth-grade teachers at her school. The field trip was funded by the Parent Teacher Organization. Ms. Stull stated that her main goal was to give students "a visual experience of the moon." She spoke about how, in their unit, they had been observing and keeping nightly moon journals for the past month, and she felt that taking the students to OMSI to see it in the planetarium show brought it to life and connected the movie to the class curriculum. Ms. Stull's philosophy is that it is most

beneficial to have the field trip as an end-of-unit event, because it allows for a great deal of content front-loading so that the material that the students will encounter during the field trip is not brand new to them.

Ms. Stull spoke of orientation activities that she did to prepare her students, which included explicit instruction in vocabulary, an explanation of what they would be doing on the field trip, and a description of how they should behave. As an orienting activity, they also went over some of OMSI's rules and summaries of the movies and vocabulary that might be challenging to students.

Day of the Field Trip

On the day of the field trip, the students arrived at school at 8:30 a.m. They began the day with their normal schoolwork. Students worked on spelling, then left the classroom to go to their music class. As they left for music, Ms. Stull instructed them to turn in their homework and place their lunches on their desk so she could get a count of the school lunches that she would need to request from the cafeteria.

While the students attended music, Ms. Stull wrapped up the last administrative details for the field trip. She stamped a set of name tags with the school's name and checked over the bus seating chart. She explained that a couple of years ago, they decided to try a seating chart for the bus, and they have never gone back. They found that with a seating chart, they could greatly reduce the noise and behavioral problems on the bus and thus were able to reduce the stress for the teachers and parent chaperones.

On the field trip, they would be watching two movies about the moon. One student would not be viewing the movies because he is from the Navajo tribe and would soon be participating in a tribal ceremony, prior to which he is not allowed to see the moon.

At 9 a.m., Ms. Stull's students returned to class and quietly waited to be dismissed for the buses. All of the students from the three fifth-grade classes quietly mingled as they waited for the bus to arrive. By 9:30 a.m., the buses had been loaded and departed for OMSI. While on the bus, students talked about their lunches and the sights they saw on the road. When the bus crossed the river and OMSI came into view, there were excited shouts and pointing. The students spent the last few minutes talking about previous visits to OMSI. One student asked Ms. Stull, "Do we have to watch both movies?" Ms. Stull responded in a surprised but also good-natured tone, "Have to? Get to!"

When the bus arrived, an OMSI staff member came on the bus and briefly welcomed the class and went over the day's events, the museum's rules, and what to do if you get separated from your group. Because the volunteer must give this speech to two buses, the students were forced to wait anxiously as the speech was given to the other bus.

The students unloaded from the bus and convened in front of the OMNIMAX movie theater. There, an OMSI employee gave them a short pre-movie talk about how OMNIMAX movies are filmed and how they are different from normal films. The employee also explained to students the safety rules and procedures for the movie

theater. The movie that the class saw was titled *Walking on the Moon* and was narrated by Tom Hanks.

As students entered the theater, they moved to find seats with their small, chaperoned groups. There was a noticeable air of excitement as they settled in. One student explained, “This is like the best theater ever,” and many others commented about the strangeness of the large, domed theater and how they felt as they moved about the theater. As the movie started, there were audible cries of excitement and enjoyment.

When the movie was over, the students were quickly ushered to the planetarium, where they saw the movie *Northwest Skies*. The students went in with little introduction and with no direction from the fifth-grade teachers.

After the movie, the students’ energy was high, and they were seen conversing about the movie. One student commented that they did not talk about a certain aspect of the solar system that they had learned about in class. Other students jumped like the astronauts pictured in the OMNIMAX movie. They exclaimed, “Can you imagine being on the moon and jumping like that and going ‘feewww’?” As the student spoke, they demonstrated with their body.

As students moved to the lunch room area, more talk was heard about what it would be like to walk on the moon. Once students were eating lunch, the talk turned to normal social chatter, and no further discussion of the movies was heard.

After lunch, the students headed out to catch their bus home, and upon arriving back at school, they continued their normal school routine with no discussion of the day's events.

Field Trip Follow-Up

As this was an end-of-unit event, there was very little field trip follow-up done. As stated in the previous section, when the students returned to school, they did not discuss the field trip as a class or do any reflective activities. Ms. Stull said in her interview that the students might have done some writing about the field trip with their writing teacher, but that she was not confident about that.

Analysis

Coding and analysis of Ms. Stull's field trip and the interview conducted after the field trip revealed that, of the teachers surveyed in this study, her field trip was the second-least structured, and she was found to have moderate levels of expectations for the field trip and for her students.

Ms. Stull's Field Trip Analysis	
Overall Structure Composite	15
Expectations	7
Field Trip Challenges or Hurdles	1
Average Student Field Trip Score	3

Table 4.

This table shows the analysis results for Ms. Stull's elements of structure and the number of times that she talked about or communicated field trip expectations to her students. Ms. Stull's field trip was moderately structured, and her expectations were not as clearly communicated as those of the other teachers in the study. She scored

> second-lowest in the ranking of field trip expectations. This data comes from the coding of field notes and teacher interviews. The chart also shows the average student field trip score, which is a composite of the positive experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student.

Limited Free Choice. As we can see from the narrative of Ms. Stull's field trip to OMSI, the structure of it was very different from others in this study. While three of the other groups went to an OMNIMAX or a planetarium show, all four of them incorporated exhibit exploration into their field trip, while Ms. Stull and her fifth-grade colleagues chose instead to have a planetarium show and an OMNIMAX show but no exhibit admission.

While at OMSI, the students did not have to complete any worksheets or assignments, and they did not have any control over the activities that they participated in. Despite this highly structured and more formal learning environment, the students still appeared to thoroughly enjoy their field trip. The following are some of the responses given by students during their interviews that illustrate their enjoyment of the field trip.

> Student 1: "She had us see an OMNIMAX movie about the Apollo and space landing and see about the planets and constellations [O, E?]. … They were really cool. I probably liked the OMNIMAX movie more [FE]."

> Student 2: "I liked all of it [FE]. … I liked the OMNIMAX movie, but I liked both [FE]."

> Student 3: “Yeah, it was really fun. I think seeing the movie in the auditorium. And I like how it was about the men walking on the moon and the visuals [L, FE].”

Students from Ms. Stull’s group appear to have enjoyed the activities that they did at OMSI, and only one student expressed a true desire to have seen more of the museum or to have had more control over the activities that day.

Goals, Expectations, Orientation, and Their Link to Understanding of Field Trip Purpose. While on the field trip, there was no articulation of Ms. Stull’s goals, expectations, or objectives, behavioral or otherwise. Ms. Stull did speak of orientation activities that she did to prepare her students, which included explicit instruction in vocabulary, an explanation of what they would be doing on the field trip, and a description of how they should behave. As an orienting activity before the trip, they also went over some of OMSI’s rules, summaries of the movies, and the vocabulary that might be challenging to students.

Three of the four students, when asked why their teacher had them go to OMSI, articulated reasons that aligned with the goals given by Ms. Stull.

> Student 1: “Because we’re learning about space, and it’s a really educational thing. It’s really cool, it’s educational, and it shows how to do things [CB].”

> Student 3: “Well—there’s a lot of science, and we were learning about the planets, and there is the planetarium [CB].”

> Student 4: “To let us know about the star constellations and journeys to the moon [O, CB].”

These three students were able to see that their field trip served to extend their learning about our solar system and the moon. The other student not included here gave a general answer about how the field trip helped them learn about science.

The following excerpt from Student 3's interview helps us further understand how well students understood the ways in which the field trip was tied to their learning and curriculum.

> Researcher: "If you were helping to organize a trip to OMSI, what would you have students do at the museum?"
>
> Student 3: "If there was an exhibit that had to do with the solar system, I would probably take them to that first for sure, and probably [take them to the] second movie [S, O]."
>
> Researcher: "But you would stick with the space theme?"
>
> Student 3: "Yeah [O]."
>
> Researcher: "It seems like you understand why they chose those movies."
>
> Student 3: "We'll, that's what we have been studying for the last two months [O]."

We see that the student understands that, although she would have liked to go to the exhibits, she sees the importance of the activities within the context of the field trip being tied to their learning about space.

Conclusion

Ms Stull's case study shows the following instructional strengths:

- Ms. Stull had clear goals for her field trip.
- She was intentional about how it connected to her classroom curriculum.
- She did orientation activities to help prepare her students for their visit to the science center.

Another interesting facet of the case study:

- Although this trip had a relatively high level of structure, the students enjoyed it and came away from it with a clear understanding of how it connected to the science they had been learning in school.

E. Mr. Whiley Case Study

Orientation to the School, Students, and Teacher

Mr. Whiley's fourth-grade class attended an all-day field trip to OMSI on November 14, 2008. Mr. Whiley's student population is located in a suburban area with mostly lower-middle-class residents. Mr. Whiley's class population is socioeconomically diverse, with approximately one-third of his students receiving free or reduced lunch. There was one student receiving special education services and four students who received English language instruction at the time of the field trip. Mr. Whiley's impression of his students' attitudes toward science was that they were relatively positive overall. He reported in his interview that he felt that it is much more

hands-on than any other subject, and that this innately appeals to students. He also stated that he felt comfortable teaching science to his students.

Field Trip Preparation

This one-day field trip was planned at the beginning of the year with the desire to make sure that the money was allocated for this purpose before funds ran out. Mr. Whiley also had previously viewed the OMNIMAX movie that he would be taking his class to, and he knew that it tied in well with his class' study of pioneers and the westward movement.

Day of the Field Trip

On the day of the field trip, the students arrived at school at 7:50 a.m. At that time, students received their name tags and worked on a practice version of a state writing test. During that time, Mr. Whiley made numerous offhanded references to his discomfort about not knowing when the bus was going to arrive. The students then worked on a creative writing assignment called "The Craziest Field Trip Ever." In this assignment, the students wrote about the biggest, silliest adventure that they could imagine happening on a field trip. Mr. Whiley told his students that this assignment was imaginative and hopefully not like their trip.

During this writing time, Mr. Whiley worked on last-minute administrative details and anxiously waited for word of the bus' arrival. One student wanted to have her dad come unplanned. Mr. Whiley was happy to have another parent volunteer

come, but it was a challenge because the parent spoke only Spanish, so they then needed to find a translator for a brief volunteer orientation.

Mr. Whiley appeared to remain anxious and tense as he sent one student to make a few more copies of the parent letter and another to find out when the bus was going to arrive. He told a few students that their parents needed to be there now, or they wouldn't be going on the bus with the class.

Finally, at 9 a.m., he dismissed the boys and then the girls to go use the restroom. When they returned, he went over a few behavioral expectations.

> Mr. Whiley: "Thanks for staying at your own desk. In a minute, we will go over a couple of things." After all of the students were in their seats, he continued, "Same thing as yesterday (the class had gone on a field trip the previous day), we want the parents to have a good time." He then continued to go over expectations of bus behavior. "When we get off the bus, we will have 10 to 15 minutes, and then we have to get to the movie 10 minutes early. I want you to explore, explore, explore. Look for ideas for science experiments. We will eat lunch and then look around a bit more, and then we will have to go to the buses at about 1 p.m."

After talking to the class, Mr. Whiley started dismissing groups to the buses. All of the chaperones received a letter with the field trip schedule and brief instructions for the day from Mr. Whiley. His main point in the letter was that he wanted students to be able to explore the museum freely. He also explained in the letter that he would not have his own group and would be a "floater" so that he could visit and interact with all of the groups. Student groups for this field trip contained three students and one adult chaperone.

Although the office said that the buses had arrived, Mr. Whiley's class found after rushing up the main lobby that the bus that had arrived was reserved for a second-grade field trip. The students waited patiently until 9:20 a.m., when the bus finally arrived. During this time, students socialized amongst themselves, but there was no observable talk about the museum.

On the bus, Mr. Whiley was observed talking to a parent chaperone. He told the parent that they would be leaving at 1 p.m., and that he enjoyed field trips but that afterward, he is very exhausted. He also said that OMSI is a pretty easy field trip. He then explained to the parents that he didn't expect the students to see everything, but that he felt it was very important for them to freely explore. He warned the parents about the ball room, which is a contained room where visitors can explore and engineer different machines that will move the balls throughout the room. He felt that it took up too much of the students' time and was not a very valuable learning experience. In his letter, he asked the parents to limit the students' time in the ball room to 10 or 15 minutes. The students rode quietly for the remainder of the trip to OMSI; no noticeable talk about the upcoming day's activities was observed.

When the bus arrived at OMSI, a volunteer boarded the bus and greeted the group, going over the day's schedule and OMSI's rules and expectations. The group exited the bus and headed straight for the OMNIMAX theater. Before the students entered, they were given a short presentation about the OMNIMAX movie theater and how IMAX films differ from a commercial movie you would see in a theater. Before

admitting them to the theater, the OMSI employee also went over theater rules and expectations.

As the students entered the theater, they found seats with their chaperones. Students made comments about the strange physical sensation that the large dome theater gave them. The title of the IMAX film was *Lewis and Clark, Great Journey West*.

After the movie, all of the small groups moved to the featured exhibit, *Mindbender Mansion*, a logic puzzle exhibit. Because of the small size of the groups, the students appeared to stay near their chaperone easily. During their time in the featured exhibit, students were observed reading the directions on the puzzle exhibits and genuinely attempting to complete the puzzles. The way that the small groups interacted with the puzzles was strongly dictated by the parent chaperone. One group's chaperone quickly moved the group along when they were not successful with a puzzle, in contrast to another chaperone, who patiently encouraged her group of students to continue. The latter volunteer never gave away the answers but probed their thinking with questions like, "What if you …" and, "Have you thought about …." This latter group spent the whole time in *Mindbender Mansion*, but the first group moved quickly through it and, with a sense of urgency, went to the second floor of the museum.

At noon, the class met in the lunch room area to eat their sack lunches and relax. While the students ate lunch, they talked amongst themselves, but no noticeable talk about their experiences that day, or about the museum, was observed.

Most of the groups finished their lunch in about 20 minutes and headed out to explore the Turbine Hall or other areas of the museum for the last hour before the bus picked them up. A large portion of the groups ended up spending their time in the Turbine Hall because of its close proximity to the lunch area and its engaging, hands-on exhibits. It was observed that students on Mr. Whiley's field trip were particularly unfocused, and although most students in this study did not read information presented on the exhibits, Mr. Whiley's students also seemed to move through the museum with a sense of urgency and haste.

At about 1:10 p.m., the students collected in the museum's entrance and boarded the bus to go back to school. As the students boarded the bus, one student was observed talking about her experience in the museum's computer lab. After this brief conversation, no other talk about OMSI or field trip experiences was observed.

Field Trip Follow-Up

The students arrived back at school at 1:45 p.m. and were back in their classroom when the teacher commented to the students, "Thanks for a great trip, guys. You did a good job." He then transitioned quickly to a spelling test and then outside for recess. When asked in his interview about any other follow-up, he said that he did not do anything, because of time constraints and the challenge of the field trip being scheduled on a Friday.

Analysis

Coding and analysis of Mr. Whiley's field trip and the interview conducted after the field trip revealed that, of the teachers surveyed in this study, his field trip was the least structured. Also, he was found to have very loose expectations for the field trip, which were not clearly communicated to his students.

Mr. Whiley's Field Trip Analysis	
Overall Structure Composite	3
Expectations	2
Field Trip Challenges or Hurdles	4
Student Field Trip Experience Score	3

Table 5.

This table shows the analysis results for Mr. Whiley's elements of structure and the number of times that he talked about or communicated field trip expectations to his students. This data comes from the coding of field notes and teacher interviews. The chart also shows the average student field trip score, which is a composite of the positive experiences referenced by the student in their interview, minus the negative or uncomfortable experiences referenced by the student.

Low-Structure Field Trip. We can see from the coding analysis that Mr. Whiley's field trip was structured quite differently from the other field trips in this study. Expectations and goals were not completely absent from Mr. Whiley's field trip, but the few that were present were very unstructured in nature. Mr. Whiley explained in his interview that he likes to take his students to OMSI at that time of year to "inspire them in science and get them revved up." This was the only goal that

was articulated during the interview. During the field trip, Mr. Whiley had two expectations that he communicated to the parents. He wanted his students to be able to "explore, explore, explore," and he didn't want them to spend too much time in the ball room, which he felt was a place where students just played around and didn't learn.

This low-structure field trip approach did not appear to strongly detract from the students' overall fun and enjoyment of the field trip, which was coded to be just slightly lower than that of the other teachers' students, on average, but it might have had some negative consequences. It was observed that students on Mr. Whiley's field trip were particularly unfocused, and although most students in this study did not read information presented on the exhibits, Mr. Whiley's students also seemed to move through the museum with a sense of urgency and haste. This theme also was present in the student interviews. One student in particular spoke of the time constraints and his feeling of being rushed while visiting the museum.

> Student 1: "I think so. I wanted to see, like, the robots, but I didn't get to see the robot [D]. … We just told each other to stay together because if we didn't, we would get lost [GSM, S]. … I wanted to go to this place where there was a turtle, and my friend wanted to go to this place where you learned about babies. We didn't have time for both, so we did 'rock, paper, scissors.' … I remember I really wanted to see some more of the *Mindbender Mansion*. We ran out of time."

This student felt that their overall experience was enjoyable, but the above excerpt from the student's interview illustrates the somewhat rushed and frantic feel of the exhibit exploration time.

Communication of Goals and Expectations. On the day of the field trip, Mr. Whiley communicated very few expectations to his students in comparison with the other teachers in this study. He told his students that he wanted them to explore, and that they should look for ideas for their science projects. No other behavioral or academic expectations were given by the teacher.

By analyzing Mr. Whiley's field trip, we see that not only did he not provide concrete expectations to the students or parent chaperones, he also planned a day that was very unstructured. The chaperones knew that they would be taking students to the IMAX movie in the morning, but the rest of the day was left for unstructured exploration of the museum in small groups. Mr. Whiley's students' responses to the question, "What do you remember?" stood out from the other teachers in this study in that they were far less likely to talk about something that the teacher had them do and more likely to talk about the experiences they had while doing the interactive exhibits. All four of Mr. Whiley's students spoke about interactive, hands-on exhibits when asked this question. Many students spoke about exhibits in the physical science hall.

> Student A: "I remember trying to make the boat, but it accidentally fell over, and the building thing, the earthquake thing, when I was throwing the balls in that place, I forget what is was called [the ball room]. My friend, she had a little toy that she always brings, and she put it in the air blowing thing and it started to fly [L, FE]."

> Student B: “I remember launching those bottles. That’s my favorite part. And I remember building something that let us launch the balls into the hoop and watching the movie [FE].”

While all of the students who were interviewed mentioned their experiences interacting with the exhibits, two students also mentioned their memories of watching the IMAX movie.

Limited Connection to Classroom Curriculum. Mr. Whiley’s field trip to OMSI was not strongly connected to his curriculum. He talked about going to OMSI at this time of year so that he was assured of some of the limited funds that were available to teachers. Although he mentioned to his students that they should be looking for ideas for their science projects, it was discovered that these projects occur much later in the year. Although he did not talk about it during the interview, the researcher was aware of the fact that the Lewis and Clark movie that the students saw ties into the Oregon state social studies standard. Although this expectation was not communicated to the students on the day of the field trip, nor was it discussed during the interview with Mr. Whiley, it might have been communicated to students prior to the researcher’s observation. There were no orientation activities before his trip and no reflection activities upon the class’ return.

Student Understanding of Field Trip Purpose. Mr. Whiley’s students’ had a characteristically low understanding of their teacher’s purposes for their visit to OMSI. This points to a connection between clearly defined goals and orientation

activities and the students' understanding of the field trip's purpose. Below are the responses given by the four students who were interviewed:

> Student 1: "For us to learn science and math and learn about animals [O]."
>
> Student 2: "Because we haven't done much science, and OMSI has a lot of science in it [O]."
>
> Student 3: "I think he chose to do OMSI because sometimes he has us do science experiments, but he doesn't do much fun things like OMSI. So, I think he wanted us to have fun and to learn science [O]."
>
> Student 4: "It was to learn about Lewis and Clark and to learn about the olden days and everything [O]."

Three out of the four students were able to give reasons that were somewhat aligned with Mr. Whiley's goals for them to explore the museum's science concepts, but it must be noted that these purposes appear to be more specific than the ones given by Mr. Whiley himself. Only one student gave a purpose that matched the unarticulated reason that their visit's purpose was to see the IMAX movie that tied into their future study of Lewis and Clark.

Field Trip Hurdles and Challenges. Numerous times, Mr. Whiley talked about the hurdles or challenges he faced in conducting his field trip. Of the teachers in this study, Mr. Whiley was found, through coding of the teacher interviews and the field notes, to have the highest rate of field trip challenges. Three major themes existed in the challenges that Mr. Whiley faced: time limitations, funding limitations, and the challenges that arose because the field trip occurred on a Friday. When asked

during his interview about follow-up or reflection activities, he referenced the challenge that he faced by having the field trip scheduled on a Friday.

> Mr. Whiley: "I probably should do some follow-up. I haven't done any follow-up [LG, UP]. It's bad to do it on Friday, no opportunity for follow-up. It's hard to do the follow-up when it's on Friday [H]. It was what was available."

For Mr. Whiley, having the field trip scheduled on the last instructional day of the week made it challenging to find time to have classroom-based activities or discussion that allowed the students to reflect on their experiences at OMSI.

Again and again, Mr. Whiley referenced in his interview that time constraints were a challenge for him. When asked about his communication of expectations to the chaperones, he said the following:

> Mr. Whiley: "There isn't time to go over all the things that you want with parents [UP]. It would be nice to have more time to do that [H]."

When asked how he knew that his students got out of the field trip what he wanted them to, he again referenced the time constraints, stating that he hadn't formally tested them and that there just hadn't been enough time to do that.

Conclusion

A few interesting conclusions can be made about Mr. Whiley's case study:

- Overall, we see from the coding of the students' interviews that the students enjoyed their experience at the science center, but that their low-structured experience might have produced some negative outcomes.
- Despite the high level of free choice on the field trip, students expressed their feelings about not being able to see or do what they wanted.
- Mr. Whiley did very little orientation and no follow-up for his field trip.
- Students in Mr. Whiley's class were less likely to talk about learning or how the field trip tied to what they were learning in school.
- The students were not able to articulate reasons that they went to OMSI that aligned with the goals stated by Mr. Whiley.

Section 2: Quantitative Findings

In an effort to further support the qualitative findings, data were collected from all subject participants via a questionnaire to assess their attitudes toward science before and after their field trip to the science center. After analyzing this data, it was found to be statistically insignificant on the classroom level and on the whole when all classes where combined. The class pre-test average and standard deviation, post-test average and standard deviation, effect size, and p-values for each group are summarized in the following table. The combined values also are shown at the bottom.

	Pre-Field Trip Survey		Post-Field Trip Survey			
	Average	SD	Average	SD	Significance	Effect Size
Ms. Tinder	28.3	5.7	27.6	7.5	0.338	0.110
Ms. Stull	24.3	7.7	25.0	6.9	0.312	0.092
Ms. Swank	31.2	6.1	30.7	6.4	0.321	-0.085
Ms. Ping	27.8	7.1	27.6	8.3	0.438	-0.031
Mr. Whiley	27.3	6.1	27.4	5.1	0.408	0.030
Combined	28.0	6.7	27.8	3.5	0.373	-0.029

Table 6.

This table shows the results for each class' pre-test and post-test questionnaires. Significance was set at $p < .05$. No results were significant.

The following two graphs show the distribution of the attitudes of the study participants before and after their field trip. From examination of these charts, we can see that, when analyzed as a whole, attitudes toward science changed very little, resulting in a lack of statistical significance.

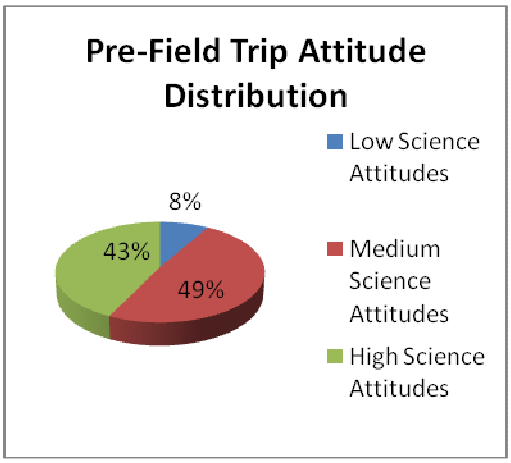

Figure 5. Graph shows the distribution of all of the study participants' scores approximately two days before their field trip to the science center.

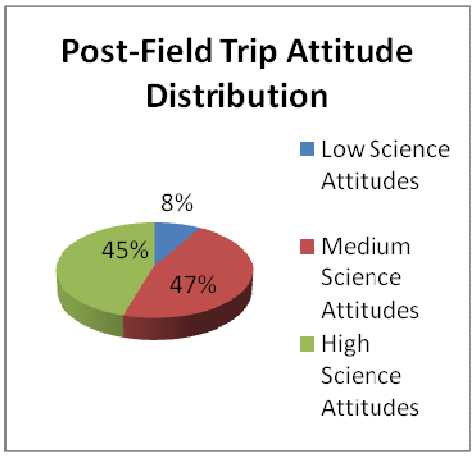

Figure 6. Graph shows the distribution of all of the study participants' scores approximately two days after their field trip to the science center.

Summary

Although the quantitative findings for this study were statistically insignificant, the five case studies presented here provide a rich understanding of the diverse instructional practices and choices made by teachers when conducting a one-day field trip to OMSI. From the student interview data and field notes, we can see that most

students enjoyed their field trip regardless of the choices that their teachers made, but that some facets of their experience can be enhanced by the choices made by teachers. These findings will be discussed in detail in Chapter V.

CHAPTER V. DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

This final chapter consists of three sections. First, the discussion section, which will review the findings and expand on the conclusions that were alluded to in the previous chapter. This discussion section is comprised of the four main themes that were discovered in this study. In the second section, the implications of this study for school field trips to science centers will be discussed. It also will address the implications of this study that apply to teachers and to science centers. In the final section, suggestions will be given for future research questions that arose from this study.

Section 1: Discussion

1. STUDENTS' UNDERSTANDING OF FIELD TRIP PURPOSE

The findings of this study suggest that when teachers have clear goals for their field trip and communicate those goals and expectations, their students have a clear understanding of the purpose of their class' field trip. It also was found that when teachers communicate their goals and expectations for the field trip in a positive manner, students link their feelings of enjoyment to their learning. This finding supports that of Griffin (1997), who showed that if teachers had a clearly defined purpose and an enthusiastic, positive attitude toward the day's trip, the students often reflected similar attitudes. Each of the teachers had a purpose for the field trip, but only three of the teachers—Ms. Tinder, Ms. Swank and Ms. Stull—had clear goals for

what they wanted to accomplish. What seems to be key is not just having a purpose or goals but also communicating goals and expectations clearly to the students. Ms. Tinder, Ms. Swank, and Ms. Stull had clear goals that they could articulate during their interviews and field notes. Analysis of these two data sources showed that they communicated their field trip goals clearly and frequently to students. Students from these groups, in comparison with those in the classes of Mr. Whiley and Ms. Ping, were more able to correctly articulate the reasons that they went to OMSI. Finally, students in Ms. Tinder's, Ms. Swank's, and Ms. Stull's groups were much more able to see the ways that their field trip tied into what they were learning in class.

Teachers' goals and expectations are just one element of the way teachers choose to structure the students' experience at the science center. This study found that when students understand that their field trip has a purpose, they enjoy the field trip more, and it can be hypothesized that enjoyment translates into more positive feelings toward science. We do see from the case studies that students across the board generally enjoyed their field trip, but that students whose teachers had clearly communicated goals and expectations were better able to understand the purpose of their field trip and spoke more highly about their enjoyment of the field trip. These students also had a lower level of discomfort surrounding their field trip and spoke less frequently of complaints.

2. TEACHERS' USE OF WORKSHEETS TO GUIDE STUDENT LEARNING

Two teachers in this study chose to use worksheets as a means to structure their students' experience at the museum. Ms. Tinder chose to use a worksheet provided by OMSI as part of the featured exhibit at the museum. This worksheet had a list of puzzles in the exhibit that, when solved, spelled out a clue, and when the clue was entered into a computer station at the exhibit, the students would receive a picture of themselves. The nature of this worksheet was similar to traditional scavenger hunts in which students answer closed-ended questions and are not asked to explain or explore any significant scientific or mathematical concepts. The completion of this worksheet was only one component of Ms. Tinder's field trip structure. This group of students spent more time in this exhibit than the other four observed groups. They also tended to collaborate more, although their teacher expressed concern when this collaboration verged on cheating. When interviewed, students expressed enjoyment of this activity. It appears from this case study that a worksheet like this serves two purposes: It helps a teacher communicate their expectations of how students will spend their time at the museum, and it encourages students to engage with individual exhibits. When done in teams, a scavenger hunt-style worksheet has the potential to foster collaboration, but it also carries the risk of students cheating to complete the assignment rather than actually engaging with the exhibits.

Like Ms. Tinder, Ms. Swank also chose to have her students complete a worksheet assignment while on their field trip to the science center. This was a much more open-ended assignment than the clue card completed by Ms. Tinder's students.

Ms. Swank's assignment asked students to find examples of solids, liquids, and gases. This worksheet appeared to serve four purposes. First, the worksheet helped Ms. Swank to communicate her learning and behavioral objectives to her students. Second, the worksheet helped to make explicit the connection between the field trip and the classroom. Third, the worksheet helped to focus students and encouraged their engagement with the exhibits and scientific dialogue. Finally, the worksheet gave the parent chaperones a structure to help guide the students' learning. The role of parent chaperones will be discussed in detail later. Ms. Swank's students seemed to enjoy this worksheet and were more likely to make references to their feelings of learning in connection to this assignment. Students were observed on the field trip engaging in more social debate and discussion about the exhibits when filling in answers to the assignment.

Ms. Tinder's and Ms. Swank's students ranked high for their fun and enjoyment. Thus, we can infer that the worksheets served the purposes above while not negatively affecting the students' experience of the trip. In both groups, the worksheet was only one component of the field trip. Previous research (Griffin, 1994, p. 124; Griffin, 1997; Mortensen and Smart, 2007) has shown that, generally, students have a negative attitude toward worksheets. One reason that this study's results differed from past research might be that both teachers incorporated into their field trip a period of time during which students could freely explore the museum without the constraints of a worksheet. This type of open-ended exploration is suggested as a desired component by Griffin (1994, 1997) and Mortensen (2007). It appears from

these results that a worksheet can be used as a constructive instructional technique without damaging students' overall opinion of their experience if the worksheets themselves incorporate choice and control or if students are given a period of time outside of completing the worksheets to explore areas of the museum that interest them.

3. THE ROLE OF ORIENTATION AND REFLECTION ACTIVITIES

Numerous studies have looked at the importance of orienting students to the museum environment in order to increase student learning (Anderson, 1997; Bafile, 2006; Falk, Martin, and Bailing, 1978; Kisiel, 2006; Myers, 2004; Paris, 1994). The findings of this study suggest that these orientation activities have the power to positively influence students' attitudes toward specific activities and toward their overall trip. Students in this study seemed to find the activities that their teacher prepared them to do to be more memorable and more enjoyable.

Four of the five teachers did some orientation activities with their students, but it was found that these activities were meant to help orient the students to activities they would be doing while at the museum, not to the physical space of the museum. One of these four teachers did conduct a discussion with her students about the makeup of the exhibits at the science center and asked students to reflect on any previous experiences they might have had at the science center. Her students had a positive experience on their field trip and were less likely than students from other groups to speak of discomfort or confusion surrounding the trip.

4. USE OF CHAPERONES ON FIELD TRIPS

Although not originally anticipated to be an important part of the structure, it was found that the way the teachers prepared and used parent chaperones on their field trip had an important impact on the experiences of the students. Of the five teachers in this study, there was a great deal of diversity in the ways they used parent volunteers. Mr. Whiley felt that he could not control who came on the field trip and had little to say about how they acted on the field trip. He also did little to prepare them for their day at the science center. Ms. Stull and Ms. Ping also appeared to have done little to prepare their parent volunteers or communicate their expectations for the field trip, but they did give the parents schedules, the names of the kids, and a list of emergency phone numbers. This information provided parents with a little more information, security, and control over the day.

Finally, Ms. Tinder and Ms. Swank had the most involvement and the highest expectations for the parent chaperones. Both teachers sent their parents a letter prior to the field trip explaining the day and their expectations for the students. The teachers provided the parents with packets containing the day's schedule, emergency phone numbers, and a copy of the student assignment. Ms. Swank again went over the expectations for her students when the parents were in the room and confirmed that the parents understood the expectations. All five teachers acted as "floaters" and did not lead a student group themselves, but Ms. Tinder and Ms. Swank were observed checking in with their parent volunteers and suggesting activities for the groups to do.

Although no conclusions can be made about how the role of the chaperones plays into the affective changes in students, it can be noted that Ms. Tinder's and Ms. Swank's groups had positive experiences at the science center, were observed to be highly engaged in the exhibits, and were less likely to run around the museum hastily than the other three groups observed in this study were.

FINAL CONCLUSIONS

After a thorough analysis, the null hypothesis for this study was found to be true. Attitudes toward science did not change significantly because of a one-day field trip to a science center. Although the original hypothesis was not proved correct, it has been shown that the instructional choices of teachers do affect students' perception of their trip and their enjoyment of the day. Students' attitudes toward science are deeply rooted and complex. This study also experienced a ceiling affect, with most of the students entering the study with moderate to high feelings toward science.

Despite the lack of change in students' attitudes toward science, this study can make two very valuable contributions to the understanding of classroom educators, museum educators, and teacher educators.

First, it was shown that the best practices for educators still apply in free-choice environments such as science centers. This study originally defined structure as a linear relationship, inversely related to free choice, but the findings from the case studies show that structure is multidimensional and very complex. This study originally presented a bell-shaped curve in which too much or too little structure

would result in negative outcomes. This study might not have seen a very highly structured visit, which might look a lot like a traditional classroom when maintaining the original definition, but the diverse structuring of field trips indicates that the original definition must be expanded to incorporate the multidimensional structure that was observed. Some structure has the effect of decreasing students' choice and fits within the original definition, but other forms of structure have the effect of orienting the students, reducing novelty, and focusing the students during their time at the museum. This study found that by using the best practices within education, such as goal setting, clear expectations, boundaries, and the use of schedules, teachers can structure an environment in a way that will ensure the most positive learning and the most affective outcomes.

Second, strong evidence from the case studies suggests that parent chaperones play an important role in structuring the experience for students. This is an element of the trip over which museum educators have little control, so it is up to teachers to carefully prepare and manage parents. More thorough recommendations for the use of parent chaperones can be found in the implications section to follow.

Teacher educators might find this study's results to be relevant to their instruction of future educators who are about to enter the field. The link between the best practices as an educator and those as a field trip leader appear to be the same, but that similarity is not always obvious to practicing classroom teachers. If teacher educators value the experiential learning and experiences of field trips, they can improve the quality and practice of new teachers' field trips by explicit instruction on

planning and executing a field trip experience. The skills needed to lead a successful field trip are not instinctive for most teachers and must, like any other skill, be practiced—and what better time to start than as a pre-service teacher?

Section 2: Limitations of the Study

It is hoped that the findings of this study will add knowledge to the field, but, like any study, there exist limitations to the generalizability of the findings. Although extensive quantitative data were collected for this study, the findings proved to be statistically insignificant on the class level as well as on the whole. This is most likely because of the complex, multidimensional, and deeply rooted nature of attitudes toward science (George, 2006). Science attitudes are stable and hard to change with a single event, and nearly all of the student participants liked science, at least moderately, so the study showed some ceiling effect.

It also must be noted that the groups observed in this study were static groups, and this might have led to some selection bias. To help control for this, facts about the class were collected using district data and teacher interviews. This information will help to interpret any anomalies because of selection bias. This study sample was selected from a pool of teachers who registered their classes to visit OMSI in the fall of 2008. This study looked at the practices of these teachers, and the findings might not be generalizable to all teachers and to all field trip experiences. For this reason, the case study model was chosen to best illustrate the experiences of these specific teachers and classes.

Another causal inference is that students in a particular school might have visited OMSI in previous years and thus have a lower level of novelty, which has been shown in previous research to increase student learning and to have other effects on the students' experience. This was taken into account, and data were collected during interviews and on the questionnaire to help in the later analysis of the findings.

Because of limitations in funding and time constraints, this study looked at one specific science center in the Pacific Northwest. Although many science centers have a similar layout and organization, OMSI might contain unique features that influenced the experiences of the students on the field trips observed in this study.

Another limitation to the design of this study results from a potential Hawthorne effect. Because of requirements of the Portland State Human Subject Review Board, parental consent was required for all participants. In the parental consent, parents were informed that the study would be looking at attitudes related to their student's field trip experience. Because this was stated on the parental permission sheet, there is a chance that students were aware of the purposes of the study, and this awareness might have had an effect on the students' answers to the survey and interview questions.

In conclusion, these findings might not be generalizable to all educators and to all field trips to science centers, but they do provide the reader with a glimpse at field trip instructional choices made by five teachers for one specific science center and how those choices affected the experiences of the teachers' students.

Section 3: Implications

IMPLICATIONS FOR CLASSROOM TEACHERS

1. PRE-TRIP PHASE

When planning a field trip to a science center, teachers need to carefully consider how it fits into their curriculum. Teachers need to have clear goals and objectives for their field trip. These goals can be diverse and do not have to be curriculum based (Braunda and Reiss, 2006), because it is not the type of goals, but rather the clear communication of the teachers' goals that appears to be helpful in increasing students' enjoyment of their field trip. When students feel that their field trip has a purpose, they view it in a more positive light, and these positive feelings toward the field trip might stimulate further interest in science and possibly a gradual increase in the positivity of their attitudes toward science.

Curriculum-based goals are not necessary for students to enjoy their field trip, but they do help to make the connection between the classroom and the field trip explicit, which enhances students' learning and students' attitudes toward their visit. Teachers should assess what worksheets or other instructional materials are provided by the museum. If none are available or those available are of low quality, teachers should consider creating their own assignments for the field trip. When making the assignments, teachers should ensure that they are open-ended enough that they do not limit the students' choice and control inside the museum. If the worksheet covers science that is being taught in the classroom, teachers should consider designing it to

improve development and integration of the classroom concepts, but teachers should not create a worksheet that is designed with the traditional classroom in mind instead of a free-choice environment such as a science center.

Whether or not teachers are using an assignment, they should make sure to prepare their parent chaperones to aid in the students' accomplishment of the trip goals and objectives. Before the field trip, teachers should send information home to let the parents know of their plans and expectations. On the day of the field trip, teachers should confirm that the parents and students know the schedule for the day, the expectations, and what to do in an emergency. If teachers give students an assignment, they should make sure the parent chaperones know what the assignment is and how to help the students. When given high expectations and well-communicated objectives, most parents are able to rise to the challenge and help students learn while still having fun.

Before the field trip, teachers should take time to orient their students to the physical space of the museum as well as to the schedule for the day. As shown by previous research and supported by these case studies, doing so will reduce anxiety and increase learning and enjoyment of the field trip. When students know where the bathrooms are, what exhibits the museum contains, and where to go in an emergency, they can feel freer to explore and focus on content. Showing students the schedule for the day and going over any assignments they might be doing that day has a positive effect.

2. DURING THE TRIP

On the day of the field trip, teachers should review behavioral expectations and learning objectives. Reviewing these expectations will reinforce the students' understanding of the purpose and goals the teacher has for the field trip. As closely as possible while at the science center, teachers should stick to the schedule that they set. Students will appreciate the structure in an environment that can be hyperstimulating and sometimes overwhelming. Teachers should not become overwhelmed or upset by hurdles that they might face throughout the day, because students look to their teacher to set the tone for the field trip.

While on the field trip, teachers should circulate to see that their expectations are being carried out. They should support the parent chaperones and encourage them to follow the guidelines and schedule that were set for the day.

3. AFTER THE TRIP IS OVER

After returning from the trip, teachers should take time with their students to reflect on the experience. This is the time when any assignments that the teacher had the students do at the museum could be reviewed. It might be helpful for students to write in a journal or on a 3-by-5 note card about their experiences before they are discussed orally. This will give the students a little more processing time before they are asked to share. If the field trip was tied to the science content being taught in the classroom, teachers should make sure those ties are reviewed and made explicit. This study supports the idea that when students feel that their field trip had a purpose and

that they learned something, they have more enjoyable memories and positive experiences.

IMPLICATIONS FOR MUSEUM EDUCATORS

The findings of this study suggest that the more clearly that teachers convey their goals and expectations for their field trip, the more enjoyable the trip will be for their students. Although this study was not able to clearly determine the affective changes that these types of communicated expectations had on students' attitudes toward science, there appears to be a link between teachers in this study who had clear goals and expectations that were communicated and students who enjoyed their experience more and understood the purpose of their trip.

Museums can help teachers set these goals in a number of ways. First, museums can offer teachers a selection of open-ended assignments that tie the exhibits to state standards and have content that their target audiences might be addressing in the classroom. For example, if a museum has a life sciences exhibit focusing on small mammals and reptiles, the museum might offer a worksheet with open-ended questions about habitats, a common part of the curriculum for elementary students. Having these types of prepared assignments available to teachers will increase the likelihood that they are used and will decrease the work that teachers need to do to create them.

Museums also can provide maps of the physical spaces at the science center to help teachers orient their students prior to the field trip. Museums also might consider creating interactive online maps that would make projecting and navigating through

the museum maps easier for teachers with increasingly common computer projector technology. This ease is essential to ensure that teachers will use the service.

Three out of the five teachers in this study spoke of using the science center's website to plan for their trip. In light of this, museums might want to include on their site a page with suggestions for a successful trip. These suggestions might include some of the recommendations made previously in the implications for classroom teachers. These recommendations can be tailored to the individual museum and will help all teachers, particularly ones who are new to the museum and its unique characteristics.

Collaboration between science centers and the teachers they serve is key to ensuring a successful field trip on which the teacher is able to accomplish their goals and the students leave with a positive experience and lasting memories.

Section 3: Recommendations

FUTURE RESEARCH QUESTIONS

- What are the long-term effects of science center visitations?

This study was not able to establish a strong correlation between the instructional choices of the teachers and their students' changes in attitude toward science. This study measured immediate attitude changes toward science. As an extension to this study, it would be interesting to investigate the potential long-term effects that the field trip and the teachers' instructional choices had on the students' attitudes toward science.

- What is the effect of a science center visit on students' attitudes toward the utility of science?

Many science centers' goals are not to teach science but to encourage interest in, and the understanding of, the utility of science. Although students' attitudes toward science did not change significantly in this study, there were numerous other affective changes that were not measured. It might be relevant to ask if students' understanding or attitudes toward the utility of science increased as a result of their field trip. Research by Hoffman and Haussler (1998) shows that without an understanding of the utility of science in their daily lives, students will become disinterested in science. This study supports the relevance of this question in helping to obtain an understanding of the affective gains obtained from science center visitations.

- Are there stronger affective gains with repeat visitations to science centers?

  In their interviews, many students expressed feelings of not getting to see all of the science center and a desire to return. This study found that the students' attitudes toward science did not change significantly because of a one-day visit to a science center, but the effect of multiple exposures to an environment like the Oregon Museum of Science and Industry is still unknown. Future researchers might find it worthwhile to investigate the changes in science attitudes of students who experience regular or repeat visitations to science centers like OMSI.

- What is the role of parent chaperones on science center visitations?

Emerging themes around the role of parent chaperones during science center visitations indicate a greater depth to the importance of this facet on the structure of class visitations. This study's research questions only began to reveal the role of chaperones on science center visitations. Information was collected from teachers through interviews and observations were made during the field trip that suggest that these adults have a powerful influence on the students' experience; the details of that influence need to be investigated further. Future questions in this area include: How do chaperones mediate the social dynamic of a small group in a free-choice environment? What type of training and preparation is helpful to parent chaperones before a visit to a free-choice science center? Finally, what size of group is ideal for the greatest affective and cognitive outcomes when visiting a science center?

REVISIONS FOR FUTURE REPLICATIONS OF THIS STUDY

This study revealed that structure is multidimensional and complex, but that by using the best practices for instruction matched with the use of parent chaperones as co-teachers, teachers can structure a field trip so that students' experiences are focused and directed while not limiting the students' choice and control.

Because it was found that students' attitudes toward science do not change significantly as a result of a one-day experience, it is recommended that future replications of this study focus on the understanding of the complex and multidimensional nature of structuring field trips like the ones in this study. Future

investigations into the various types of structuring that occurs on class trips will help build a theoretical framework for understanding the complex nature of this phenomenon.

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APPENDICES

Appendix A. Teacher consent form

How does the degree to which teachers structure field trips affect students' attitudes toward science?

Dear [insert teachers name],
You have been invited to participate in a research study conducted by Meghan Briggs from Portland State University. The researcher hopes to learn the best ways for teachers to structure students' science fieldtrips in order to achieve the most positive outcomes in students' attitudes toward science. This study is being conducted in partial fulfillment of the requirements for a Master's in Science Teaching and is under the direct supervision of Dr. Bill Becker from the Center for Science Education. You were selected as a possible participant in this study because your class will be attending OMSI as part of your previously scheduled lesson plans. If you choose to participate, you will be asked to have your students fill out a short one page fieldtrip pre-test. Next you will be asked to allow the researcher to observe the field trip activities in order to make some notes about the students' experience. Two to three school days after the field trip you will be asked to allow the researcher to administer a very short questionnaire to the class (15 minutes max). At the same time the research will ask your help in selecting two boys and two girls from the class who will be asked a few more additional questions about their visit to OMSI. Finally you will be asked to meet with the researcher to answer a set of questions about your plans and goals for the field trip. This interview will take approximately thirty minutes. While participating in this study, it is possible that you may feel slightly inconvenienced, however, be assured that the researcher will work with your schedule to minimize this.

To thank you for your time and participation you will be given a $40 gift certificate to the OMSI bookstore and two adult admission passes for your own personal use. Your students may not receive any direct benefit from taking part in this study, but the study may help to increase knowledge that may help others in the future to better engage their students when visiting science centers like OMSI.

Any information that is obtained in connection with this study and that can be linked to you or your identity will be kept confidential. You and your students' identities will be kept confidential by keeping names separate from information given. Students being interviewed will be given a pseudonym for later reference.

Participation is entirely voluntary. Your decision to participate or not will not affect your relationship with the researcher, OMSI or Portland State University in any way. If you decide to take part in the study, you may choose to withdraw at any time without penalty. Please keep a copy of this letter for your records. If you have concerns or problems about your participation in this study or your rights as a research subject, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 600 Unitus Bldg.,

Portland State University, (503) 725-4288 / 1-877-480-4400. If you have questions about the study itself, contact Meghan Briggs at briggs.meghan@gmail.com or (503) 236-3567.
Your signature indicates that you have read and understand the above information and agree to allow your student to take part in this study. Please understand that you may withdraw your consent at any time without penalty, and that, by signing, you are not waiving any legal claims, rights or remedies. A copy of this form has been provided for your own records.

_____ _____

Signature Date

Appendix B. Parental consent form

How does the degree to which teachers structure field trips affect students' attitudes toward science?

Dear Parents/guardians,

Your child has been invited to participate in a research study conducted by Meghan Briggs from Portland State University. The researcher hopes to learn the best ways for teachers to structure students' science fieldtrips in order to achieve the most positive outcomes in students' attitudes toward science. This study is being conducted in partial fulfillment of the requirements for a Master's in Science Teaching and is under the direct supervision of Dr. Bill Becker from the Center for Science Education. Your child was selected as a possible participant in this study because he or she is part of Mr./Ms. [insert teachers name] class who will be attending OMSI as part of their previously scheduled curriculum. If you agree to allow your student to participate, he or she will be filling out a short survey before attending OMSI and then will be observed, along with his or her fellow classmates, while at the Oregon Museum of Science and Industry (OMSI). Upon return to the school your student will be asked to fill out a short survey about their experience while at OMSI. He or she may also be one of a few select students that will be asked if they would be willing to speak with the researcher about their visit in a little more detail. These interviews will be under fifteen minutes and will be conducted at the school. For the interviews, students' answers will be tape-recorded in an effort to maximize accuracy. While participating in this study, it is possible that your student may feel slightly uncomfortable about answering in the survey or during the interview and it make take away a small portion of class time if your child is selected to be interviewed. To safeguard against this it will be communicated to your student that at any time they can choose not to answer a question. They can also at any time choose not to participate at all, and we will make sure that they are informed of this fact.

You and your student may not receive any direct benefit from taking part in this study, but the study may help to inform your child's teacher about the best activities to use on field trips in order to increase students excitement around science. Any information that is obtained in connection with this study and that can be linked to your child's identity will be kept confidential This information will be kept confidential by keeping names separate from information given by the student and students who are selected to be interviewed will be given a pseudonym for later reference. You and your students' participation is completely voluntary. Your student does not have to take part in this study, and it will not affect his or her grade or relationship with his or her classroom teacher. If you have concerns or problems with your student participation in this study, please contact the Human Subjects Research Review Committee, Office of Research and Sponsored Projects, 600 Unitus Bldg., Portland State University, (503) 725-4288 / 1-877-480-4400. If you have questions about the study itself, contact Meghan Briggs at briggs.meghan@gmail.com or 503- 236-3567.

Please sign below if you **DO NOT** want your student to take part in this study. Please understand that you may withdraw your consent at any time without penalty. A copy of this form has been provided for your own records.

_____

Signature Date

Appendix C. Student assent form

Your name _____

Your parents (or guardian) has said that it is okay for you to take part in a project that will help teachers understand what activities are best to use when planning a science field trips. If you choose to do it, you will be asked to answer a few questions on a survey and possibly talk to me about your trip to OMSI. If you want to rest, or stop completely, just tell me—you won't get into any trouble and your grade will not be affected. In fact, if you don't want to do it at all, you don't have to. Just say so. Also, if you have any questions about what you will be doing, just ask me to explain.

If you do want to try it, please sign your name on the line below. Remember—you can stop at any time, and if you decide not to take part anymore, let me know.

Signed _____

Date _____

Appendix D: Pre-field-trip teacher phone interview script

Teacher Pre-Interview

Interviewer will welcome the teacher and introduce themselves. Then the interview will tell the teacher: "I am going to ask you a few questions about your plans for your fieldtrip to OMSI. At any time if you don't know the answer or if you do not feel comfortable answering the question just let me know and we can move on to the next question. Do I have your permission to tape record our conversation?" If the teacher says yes, say thank you. If at any time you have any questions just let me know.

Teacher's name:
School name:
Grade Level:
Date of interview:
Name of Interviewer:

1. What are your goals for the field trip to OMSI?
2. How do you expect students to spend their time?
3. Who will the students be seeing the museum with?
4. Does the field-trip tie to anything you are learning in class?
5. How did you decide to go to OMSI?
6. What resources did you use, if any in planning for your trip?
7. How would you describe the range of science attitudes in your class?

If you decide to participate, you will be asked to administer a short (5-10 minute max) pre-test survey to your students. I would also like to help chaperon on the fieldtrip. While on the field trip I will make some notes about the students' experience. After the field trip I would like to return to administer a short post test questionnaire to the class (15 minutes max). I will also ask your help in selecting two boys and two girls from the class that I will ask a few more additional questions about their visit to OMSI. Finally I would like to meet with you to ask a set of questions about your plans, goals and about your experience conducting the field-trip. This interview will take approximately thirty minutes.
As a result of this study, you may be slightly inconvenienced, however, I assure you that I will work with your schedule to minimize this and hope that my assistance on the fieldtrip will be helpful. If you would be interested in participating we have a small gift of $40 to the OMSI bookstore and 2-admission passes for your own personal use. The direct benefit you may receive from participation in this study may be small, but the study may help to increase knowledge that may help others in the future to plan their field-trips effectvely.

If the teacher says they would be interested in participating set up a time to meet for the field-trip and for the follow up interviews and survey. Explain that you will be mailing a packet with permission forms and pre-test surveys that should be completed before the field-trip.

Ask if there are any questions. If the answer is no, thank the teacher for their time!

Appendix E. Teacher interview procedure

Teacher Post-Interview

Interviewer will welcome the teacher and introduce themselves. Then the interview will tell the teacher: "I am going to ask you a few questions about your fieldtrip to OMSI. At any time if you don't know the answer or if you do not feel comfortable answering the question just let me know and we can move on to the next question. Do I have your permission to tape record our conversation?" If the teacher says yes, say thank you and explain that you will also be taking a few notes as well. Begin.

Teacher's name:
School name:
Grade Level:
Date of interview:
Name of Interviewer:

1. Would you please give me a short narrative of your schools and class? (3-5 sentences). **If the teacher is unclear about this the interview can share the following prompt:** "An example of this might be 'my school is a small elementary school with approximately 250 students that come from mostly middle class white families. My class is also mostly white, middle to upper class. My students are active learners who love science'."
2. Do you feel like you met your goals for the field trip to OMSI?
3. What did you do at school to prepare the students for their field trip? Aprox number of hours?
4. How long was your visit to OMSI?
5. How did you expect students to spend their time? Did that happen as you expected?
6. Did you think the field-trip was a success? How did you know this?
7. Do you have plans for follow-up at school after the field trip? If so, what are/were they? Aprox. Number of hours?
8. What resources did you use, if any in planning for your trip?
9. Was their interaction with OMSI staff before you're visit? What was the nature of this interaction?

10. Were there any obstacles in planning your trip?

11. What role does this trip play in your science curriculum? How do you feel about science?

12. How comfortable are you teaching science?

13. How would you describe the range of science attitudes in your class?

14. What could OMSI do to make the trip a better educational experience for your students?

15. Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

16. Do you have anything else you would like to share with me?

If the answer is no, thank the teacher for their time!

Appendix F. Student interview procedure

Student Interview Sheet

Interviewer will welcome the student and introduce themselves. Then the interview will tell the student: "I am going to ask you a few questions about your fieldtrip to OMSI. At any time if you don't know the answer or if you do not feel comfortable answering the question just let me know and we can move on to the next question. The things you say are important to me so I am going to take notes on the computer but just in case I don't catch something you say do I have your permission to tape record our conversation?"

- **If the student says <u>yes</u>, say thank you and start the tape recorder. Begin.**
- **If the student says <u>no</u>. Let them know that's totally fine and you will just take notes on the computer. Do not tape record. Begin.**

Student name:
Classroom teacher's name:
School name:
Date of interview:

1) Do you like science? Why or why not?
2) Did you enjoy your field trip to OMSI?
3) Can you tell me a little bit about why your class went to OMSI?
4) Have you been to OMSI before? How often and with whom?
5) What do you remember about your trip to OMSI?
6) How did you see the museum? Did your class stay together as one big group or something else?
7) Did your teacher have you do any specific activities at OMSI? If so what did you think of them?
8) How did you like doing those things
9) In general did you get to see and do what you wanted at OMSI? Why or why not?
10) What did you get to do that you really wanted to do?
11) What did you have to do that you really didn't want to do?
12) Would you like to go back to OMSI? Why or why not?
13) If you were helping to organize a trip to OMSI, what would you have student do at the museum?
14) Is there anything else you would like to share with me?

Appendix G. Student survey instrument – Pre-test

Teachers name _____

Circle one: Male / Female

Date _____

Primary language spoken at home_____(Example: Spanish, English)

Using the following 1 - 5 scale, please show, by circling the most correct response,

1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
I really like science.				
1	2	3	4	5
I feel comfortable doing science.				
1	2	3	4	5
I believe the science I learn in school is useful.				
1	2	3	4	5

the degree to which you agree with the statements listed below:

I believe the science I learn outside of school is useful

1 2 3 4 5

I want to be a scientist when I'm older.

1 2 3 4 5

I really don't like science.

1 2 3 4 5

Does science make you feel – (for each question check yes, no or I don't know.)

A. Happy? Yes ____ No_____ I don't know____
B. Interested? Yes ____ No_____ I don't know____
C. Dumb? Yes ____ No_____ I don't know____
D. Excited? Yes ____ No_____ I don't know____
E. Successful? Yes ____ No_____ I don't know____
F. Bored? Yes ____ No_____ I don't know ____

Favorite school subject_____

Second favorite school subject_____

Third favorite school subject_____

Appendix H. Student survey instrument – Post-test

Teacher's Name _____

Circle one: Male / Female

Date _____

Language spoken at home:_____(Example: Spanish, English)

Using the following 1 - 5 scale, please indicate, by circling the most correct response, the degree to which you agree with the statements listed below:

1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
I really like science.				
1	2	3	4	5
I feel comfortable doing science.				
1	2	3	4	5
I believe the science I learn in school is useful.				
1	2	3	4	5
I believe the science I learn outside of school is useful				
1	2	3	4	5
I want to be a scientist when I'm older.				
1	2	3	4	5
I really don't like science.				
1	2	3	4	5
At OMSI I was able to see what I wanted to see.				
1	2	3	4	5
At OMSI I was able to go where I wanted.				
1	2	3	4	5
I liked the activities that my teacher planned for us at OMSI.				
1	2	3	4	5

I felt comfortable at OMSI.

1 2 3 4 5

I had fun learning science at OMSI.

1 2 3 4 5

I enjoyed the activities that I did at OMSI.

1 2 3 4 5

I want to go back to OMSI on another field trip.

1 2 3 4 5

Favorite school subject_____

Second favorite school subject_____

Third favorite school subject_____

Please tell me one thing you learned about science on your trip to OMSI

Please tell me one thing you remember about your fieldtrip to OMSI that was the most fun.

Does science make you feel (for each question check yes, no or I don't know.)

A. Happy? Yes ____ No_____ I don't know____
B. Interested? Yes _____ No_____ I don't know____
C. Dumb? Yes _____ No_____ I don't know____
D. Excited? Yes _____ No_____ I don't know____
E. Successful? Yes _____ No_____ I don't know____
F. Bored? Yes _____ No_____ I don't know____

Including your field trip how many times have you been to OMSI? (check one)

A. ___ 1 time
B. ___ 2 times
C. ___ 3 times
D. ___ More than 3 times
E. ___ I've never been to OMSI

Appendix I. Portland State University Human Subjects approval memo

Portland State
UNIVERSITY

Human Subjects Research Review Committee

Post Office Box 751
Portland, Oregon 97207-0751

503-725-4288 tel
503-725-3416 fax
hsrrc@lists.pdx.edu

August 12, 2008

To: Meghan Briggs

From: Nancy Koroloff, HSRRC Chair

Re: Approval of your application titled, "How does the degree to which teachers structure field trips affect students' attitudes toward science?" (HSRRC Proposal # 08630).

Dear Meghan,

In accordance with your request, the Human Subjects Research Review Committee has reviewed your proposal referenced above for compliance with DHHS policies and regulations covering the protection of human subjects. The committee is satisfied that your provisions for protecting the rights and welfare of all subjects participating in the research are adequate, and your project is approved. Please note the following requirements:

Changes to Protocol: Any changes in the proposed study, whether to procedures, survey instruments, consent forms or cover letters, must be outlined and submitted to the Chair of the HSRRC immediately. The proposed changes cannot be implemented before they have been reviewed and approved by the Committee.

Continuing Review: *This approval will expire on August 12, 2009.* It is the investigator's responsibility to ensure that a Continuing Review Report (available in ORSP) of the status of the project is submitted to the HSRRC two months before the expiration date, and that approval of the study is kept current.

Adverse Reactions: If any adverse reactions occur as a result of this study, you are required to notify the Chair of the HSRRC immediately. If the problem is serious, approval may be withdrawn pending an investigation by the Committee.

Completion of Study: Please notify the Chair of the Human Subjects Research Review Committee (campus mail code ORSP) as soon as your research has been completed. Study records, including protocols and signed consent forms for each participant, must be kept by the investigator in a secure location for three years following completion of the study.

If you have questions or concerns, please contact the HSRRC in the Office of Research and Sponsored Projects (ORSP), (503) 725-4288, 6th Floor, Unitus Building, 4th & Lincoln.

Cc: William Becker

Appendix J. Examples of Coded student interviews

Tinder – Student 1
Date of interview: 10-8-08
R: Do you like science? Why or why not?

S: Yes I like science [A].

R: why is that?

S: I like learning about planets, maybe if it was a different subject I might not like it as much but I like learning about planets [A].

R: Did you enjoy your field trip to OMSI?

S: Oh yeah, I really enjoyed it [FE].

R: Can you tell me a little bit about why your class went to OMSI?

S: We went because of science I guess, we wanted to learn science. Our teacher thought it would be fun. She went there before we went and saw all the exhibits [Somewhat O].

R: Have you been to OMSI before? How often and with whom?

S: I usually go with my mom, and I remember an exhibit about the Titanic and that was really fun. A couple of other times. there was one about polar bears and you could weigh yourself as a polar bear [P].

R: What do you remember about your trip to OMSI? I remember, like the one we went to with the class?

S: – [yeah] when we went to the planetarium, and the mind bender mansion [S]. We went upstairs for the last ten minutes and we went to the upstairs and there was a black board that would tell if your hand was hot or cold [L].

R: Do you remember any other fun things?

S: We didn't go down to the water place but when we walked by it to lunch I saw it [D].

R: And that looked fun?

S: Yeah.

R: How did you see the museum? Did your class stay together as one big group or something else?

S: With my group. We spread out a lot in the mind binder mansion. Me and my friend Anna kinda broke off from the group and were solving puzzles by ourselves [S, GSM]

R: You and your friend who broke off from the group and looked around?

S: [nods head]

R: Did your teacher have you do any specific activities at OMSI? If so what did you think of them?

S: She really wanted us to go to the mind mansion and then we could do whatever we wanted and then we went to the planetarium show [E, S].

R: How did you like doing those things?

S: Yeah they were really fun I like them a lot [FE].

R: In general did you get to see and do what you wanted at OMSI? Why or why not?

S: Yeah, I think so. I kinda wanted to go to the rocket water place [GSM, CC, D].

R: You didn't get to go there because of time or why?

S: Didn't get to see it because we had to finish in the mind mansion and so we didn't have time [D].

R: What did you get to do that you really wanted to do?

S: Umm [pause] I guess the mind mansion. We were there for hours. I really like the carts and I got to do that and it was fun [FE].

R: Anything else that you wanted to that you really wanted to do, things you saw or had in mind before hand?

S: I really wanted to see a planetarium show, I really like watching up in the sky, it wasn't really a sky but it felt like it [FE].

R: What did you have to do that you really didn't want to do?

S: Umm, I didn't – no - Not really I liked everything [FE].

R: Would you like to go back to OMSI? Why or why not?

S: Yeah, cause I just want to do the things that I didn't get to do and they change exhibits so I can see the different ones.

R: If you were helping to organize a trip to OMSI, what would you have student do at the museum?

S: Umm-- I don't – maybe – maybe like I would do different things, like a variety [S, GSM].

R: so would you require kids to go to different places?

S: I wouldn't require them but I might strongly encourage them to go to others.

R: Is there anything else you would like to share with me?

S: I don't know—

R: That's ok. I actually thought of one more question for you. What did you think of the card in the mind binder manson?

S: I don't think we did that one – OH the paper yeah I liked that [S].

R: Did you guys complete it?

S: We kinda tried to find just those puzzles and then we went and did other things [E, S, CC].

R: Okay, thank you very much for talking with me.

Swank – Student 1

Date of interview: 11-18-08

R: Can you start off by telling me a little about yourself, maybe your interests or you favorite parts of school.

S: The main sport I like to play is chess and my favorite subject is science [A] that's why I was looking forward to going to OMSI. I'm a single child.

R: Do you like science? Why or why not?

S: I just, I used to have my favorite subject was reading, but once I learned a little bit about science I wanted to learn more and more and more [A]

R: What do you think about science that makes it your favorite?

S: my favorite thing in science is astronomy and I even have a telescope [A].

R: Ah, you're going to like fifth grade, that's when you get to learn a lot more about our solar system.

R: Did you enjoy your field trip to OMSI?

S: Very much, I especially like the turbine hall where you get to go in a shuttle like an astronot and push buttons and flip switches [FE]. I also like where you pump water into a bottle and it rockets up into the air. Those are my two favorite things at OMSI [FE].

R: Can you tell me a little bit about why your class went to OMSI?

S: Because she wanted to do this survey about all these things because she wanted to do this survey and she thought it would be good to end up the science unit [O].

R: Have you been to OMSI before? How often and with whom?

S: Once I went when I was at David Hill and then I got transferred and so I got to go again [P].

R: When was that? Last year?

S: Yeah last year.

R: Cool, and that was with your class, teacher?

S: yeah.

R: What do you remember about your trip to OMSI?

S: I remember getting to put together these card board blocks that had words on them, like ram and CPU and we got to put together a fake computer with those blocks, the computer screen said that you when you put them in the wrong place [L]. Also there is a chemical lab where you get to put together different colors and different scents [L]. There is this one thing where you got to create a boat and um you got to see if you sailed and floated and you got to great a jet with paper and got to see if that stayed up you have to make sure it has perfect structure [L].

R: How did you see the museum? Did your class stay together as one big group or something else?

S: Well we got to just move around the museum and just move around to the turbine hall, then we went to this really cool dinosaur exhibit, and then we played some fun computer games and then we spent the rest of the day in the turbine hall. We had one parent volunteer and then um her son and then three of my other classmates [S, CC].

R: Did you get to pick those groups] no Ms. Sylvester picked groups?

S: Yah I only got to go to my favorite place once, the pendulum.

R: Why do you think that was?

S: They wanted to see other parts of the museum [GSM].

R: So you had to share the time?

S: um-hum [GSM].

R: Did your teacher have you do any specific activities at OMSI? If so what did you think of them?

S: Only one where you had to find the solids liquids and gasses and explain the experiments that you saw at OMSI [S, E/O?].

R: All of them?

S: Well not literally all of them but all of the ones that you saw, solids, liquids and gases.

R: How did you like doing those things?

S: I would have liked more time to enjoy the museum, but I had some fun doing this wild goose hunt for all these types of matters [CC, S, D].

R: Was it hard? Did you get your sheet filled up?

S: It was pretty hard but I ended up getting a minimum.

R: What was the minimum?

S: About half the sheet.

R: In general did you get to see and do what you wanted at OMSI? Why or why not?

S: Pretty much.

R: How did you decide what to see as a group?

S: We looked at the maps, they were this liminated glass, on the wall or on this structure at the side of the room, they had all over the museum [OPS]. We looked at those maps and then we saw where we wanted to go next [GSM]. We went there and then just went to the next map and did the same thing, over and over again until it was time for lunch and then to go home.

R: How did you know when you should go over and look at the map?

S: When all of our group got to do it [GSM].

R: What did you have to do that you really didn't want to do?

S: One thing where the rest of the group wanted to go, hop scotch letter puzzle where you had to spell words by jumping and then jumping on finish before the time was up.

R: - and you didn't think that was worth your time-

S: I just want to go to the pendulum that was in the same room [D].

R: Would you like to go back to OMSI? Why or why not?

S: Very much because it might get old b/c it's my third time but I still really wanted to go there [FE].

R: If you were helping to organize a trip to OMSI, what would you have student do at the museum?

S: I wouldn't make my students write a whole paper about solids, liquids and gases, unless the establishment made me do it [S, CC].

R: why would you do that?

S: I would want my students to have fun and get to do the different experiments [S, CC].

R: Do you think that sheet distracted you or what?

S: She sort of distracted me because she said that I had to do the sheet or I wouldn't get to do - some fun on Friday because if we didn't get this done we would have to go to study hall and finish it. I wanted to get this done but I also wanted to do the experiments. It was pretty hard but I ended up getting it done [S, CC].

R: Is there anything else you would like to share with me?

S: I liked learning about the rocket, yah, you had to pump in the water and air or it wouldn't go anywhere. And um last time I went there it went so high and so much water in it, it got us wet, I just wanted to go there again, again, again [FE].

R: how do you think that's science?

S: Well you have to put in the right amount of water and oxygen in order to make it go [L].

R: So you have to experiment to find the right amounts?

S: yeah.

R: Thank you for talking with me today.

Wiley – Student 1

Date of interview: 11-18-08

R: Tell me a little about yourself.

S: My favorite hobby is to collect marble rocks., I collect interesting coins, I like forth grade its very fun and Mr. Smith.

R: Do you like science? Why or why not?

S: I like science because it's like fun and you get to learn new things. When I get science, I learn new things and we do lots of new experiments [A].

R: What has been your favorite experiment.

S: It was this where we made a kinda volcano.

R: Did you enjoy your field trip to OMSI?

S:Yeah I enjoyed it, it was really fun and I didn't know they had robots [FE].

R: Can you tell me a little bit about why your class went to OMSI?

S: I think he chose to do OMSI because sometimes he has us do science experiments but he does do much fun things like OMSI, So I think he wanted us to have fun and to learn science [O].

R: Have you been to OMSI before? How often and with whom?

S: I've been to OMSI before with my dad, we went to this place where you put water in and you shot the bottle up [P].

R: What do you remember about your trip to OMSI?

S: I remember when we watched Lewis and Clark and I didn't know that Sacagawea had a baby when she was 16 [L].

R: what did you think of that movie?

S: It was very interesting and I learned a lot of things.

R: Do you think you learned a lot of science in that movie?

S: Not really, b/c it told of the adventures of Lewis and Clark. When I went upstairs it was pretty interesting b/c it told you about light and the ball, robot arm thing [FE].

R: How did you see the museum? Did your class stay together as one big group or something else?

S: Some groups went to other places but my group stayed together as a group and decided when to go [S, CC, GSM].

R: How did you decide to stick together?

S: We just told each other to stay together because if we didn't we would get lost [GSM, S].

R: Who was in your group?

S: Three girls and chaperon.

R: How do you think you decided to go to a new thing – did you take a vote, or –

S: I wanted to go to this place where there was a turtle and my friend wanted to go to this place where you learned about babies, we didn't have time for both, so we did rock paper sissors. We did this a couple of times [GSM, CC].

R: That's a good method.

R: Did your teacher have you do any specific activities at OMSI? If so what did you think of them?

S: He let us go with our group. Sometimes we saw him and we walking around with him.

R: In general did you get to see and do what you wanted at OMSI? Why or why not?

S: I think so, I wanted to see like the robots but I didn't get to see the robot [D].

R: Why was that?

S: well, me and my dad went there and it was really cool, I couldn't find it this time.

R: So you couldn't find where it was this time?

R: What did you get to do that you really wanted to do?

S: The thing I really wanted to do was go to the ball room. I've never been there before and the other one was I got a chance to play with the water bottle shot, cuase' I've only done it once and I got a second or third time [CC, FE].

R: What did you have to do that you really didn't want to do?

S: Not really because when I was really little I used to be scared of that place and I would drag my dad away from them but I'm not scared anymore and it's actually pretty interesting.

R: Would you like to go back to OMSI? Why or why not?

S: I would like to go to OMSI and we did get to see lots of cool things. I would really, really want to go back [FE]. I remember I really wanted to see some more of the mind bender mansion. We ran out of time [D].

R: If you were helping to organize a trip to OMSI, what would you have student do at the museum?

S: If I was in charge I would, say to have some freedom, say to stick together and you can go anywhere you want and it would be fun [CC, S].

R: So you would have liked to do some stuff as a big group?

S:Yeah because there was some stuff. And if some kids didn't agree we would take a vote. Because something's they didn't get to see [D].

R: Is there anything else you would like to share with me?

S: (shakes head)

R: Thank student for being involved in the study and for their time!

Appendix K. Coded teacher interviews

Ms. Tinder

R: Would you please give me a short narrative of your schools and class? (3-5 sentences). **If the teacher is unclear about this the interview can share the following prompt:** "An example of this might be 'my school is a small elementary school with approximately 250 students that come from mostly middle class white families.

> T: --- We have a very diverse community. Especially in the emersion program fifty percent are alngo speaking and fifty percent Spanish speaking. They come from different economic backgrounds, diverse family groupings, mom and dad households, mom household etc. O okay, I think they are excited about science. Teachers don't have a lot of time to study science, with the state writing test, reading tests and so on, but in fifth grade they have a science test so we get to focus on it. We have district provides us with science kits that cover science standards but they are pretty bad. But in my case I try to do a lot of hands on, and let them decide what they want to study. I see a lot of excitement. They got to study the planet of their choice. They do moon journals where they go out and study and do drawings of the moon[C-Pre]. In the main exhibit hall there were so many kids I think that was a challenge. [H]

R: Did you think the room was really crowded?

> T: Yes I did because not extremely crowded, but crowded enough so that they had to wait. Just that exhibit though, not the other ones they didn't have to wait in the labs.

R: Do you feel like you met your goals for the field trip to OMSI?

> T: Yes, first of all because one of my goals had nothing to do with science, I wanted to see how they would behavior in a very active hands on environment and see they dynamics of the group because I've only had them for a month and I wanted to check them out [G]. They definitely loved the planetarium. A lot for them wrote about it in journals, and are using it in their project [planet projects][K]. Because they had questions about something specific when they went in they got more out of it [E]. Another thing that I liked, there are some student of mine that don't have a lot of money and for some of my student this was their first experience at omsi, and to be able to provide that was great [G].

R: What did you do at school to prepare the students for their field trip? Aprox number of hours?

T: Ok so I taught about the planets and gave them specific concepts so they had goals and me myself I went to OMSI two days prior and I did the puzzles and got the answers and saw the other areas and decided that because those were permanent ones I would take them to the other [mind binder mansion] first and then if they had time they could see the others [C-pre, T]. And then I tried to figure out if five kids could work at the chemistry or physics labs and it was not too many kids they have like way more than five stations, so I did that and the day before we went I made copies of the clue card and showed it to the students and went over how it worked, how you have to solve the puzzles and then find the clues and put them into the computer [T, C-pre]. And I made the schedule so all the parents had a copy of the schedule, which gives them some independence so when they are done with the mind bender mansion they actually have the choice to take their kids to a different area [T, E].

R: How long was your visit to OMSI?

T: 9:30am – 1:15pm, 4 ½ hours it was like an all day thing.

R: How did you expect students to spend their time? Did that happen as you expected?

T: I wanted them to work together, I had told them that they would get a prize if they get all the password [G]. And then someone said 'what if each of use gets a clue and then we combine them to get the password, would that be ok?' I thought that would be ok because I wanted to hear that answer because that's teamwork. But I was disappointed because some of them got tired and started cheating. It was a fine line between teamwork and cheating [UP]. Um and I wanted them to touch and experiment everything but at the same time be respectful [G].

R: Did you think the field-trip was a success? How did you know this?

T: Yes. Well the kids were very happy and that's important [K]. I saw that there were concepts that were being reinforced, I heard things that the kids knew, and they saw those again and then they used those in their projects [K].

R: Do you have plans for follow-up at school after the field trip? If so, what are/were they? Aprox. Number of hours?

T: Journal entries when they came back, with prompt about OMSI [C-post]. Today I talked about what they remembered from OMSI that they put in their poster [C-post]. I put the website on my class website so parents and kids can go on their and check it out because its really interesting but with elections coming up that's about it [C-post].

R: What resources did you use, if any in planning for your trip?

T: Nothing really because I just went there.

R: Was their interaction with OMSI staff before you're visit? What was the nature of this interaction?

T: For some of the puzzles I couldn't do, so when I visited they helped find the answer and helped give staff helped give teacher clues to help kids get to the answer with out giving them the answer. The day I went before hand I saw workers but the day we went on the fieldtrip I saw volunteers. They also told me how much time it would take to solve all the puzzles. (1 ½ -2 hrs). That helped me re-arrange my whole trip because when they said that I was like ok that is going to be too much time so I want them to focus on this [T, G].

R: Were there any obstacles in planning your trip?

T: Nope

R: What role does this trip play in your science curriculum? How do you feel about science?

T: Oh, it ties right into the Earth moon and stars with the planetarium (planetarium) the logic and puzzles prepares them for the state test [ST, CB]. Right now they don't know this but a lot of things they saw in the turbine hall, it's going to be reinforced with a kit we have called variables, it's pretty experiemental, so I'm hoping when I do that the kids will think back to what they saw and did at OMSI[ST, CB]. And then at the end of the year I teach sex ed. at the end of the year so that will tie into some of the stuff they saw in the life science hall [ST, CB].

R: How comfortable are you teaching science?

T: 7 or 8 I'm pretty comfortable but it does require me to study it before, there are some concepts that are hard for me.

R: What kind of materials would you like to see if you could?

T: We would like to have stuff that kids can manipulate and stuff that teaches to the standards. It has to be hands on and it has to be something that the kids want to know about. It has to be discovery, we need to trick them into thinking they want to know this stuff.

R: How would you describe the range of science attitudes in your class?

T: No resistance to science.

R: What could OMSI do to make the trip a better educational experience for your students?

> T: They let you go prior to your fieldtrip with your family and I think that that is the most important. Um, maybe Teacher's guides to more of the other areas of the museum. Science behind it would be good, to help teachers prepare [G, T].

R: Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

> T: No Fifth grade students sometimes go to the OMSI camps and those are excellent.

R: Do you have anything else you would like to share with me?

Ms. Swank

R: Would you please give me a short narrative of your schools and class? (3-5 sentences).

> T: We are a title one school, we have above 50 percent and our school has over sixty five percent and we are inner city for Hillsboro, our population is drawing from other parts of town based on the redistribution of school boundries. A lot of our students are coming from low are housing.

R: How about your science curriculum?

> T: My kids were really excited when we started studying matter, and several of them cheered when it made its way onto the schedule, I've heard very little against it. We use "Barbara Banister" and we have a pretty good collection of hands on, so the kids have a pretty good experience with lots of past hands on experience. So Barbara Banister is a lady who put together a full science kit. They don't see it as a book thing because we only use kits. Lots of showing them and then having them do predictions and then tying that together and. It definitely has wholes across the curriculum with overlaps between grades. I've taught the first grade one and it looks – pretty much the same. The opportunity for discussion in forth grade is much greater.

R: Do you feel like you met your goals for the field trip to OMSI?

> T: I did, I was curious as to whether or not parent volunteers would help to structure an environment where students were not just running from activity to activity and instead engaging in things [G]. From my own experience and what I saw of the experiences of the kids it seemed like they were [K]. They were, with their scavenger hunt, looking for examples of solids, liquids and gases [K]. I think a way higher percentage of kids used the labs this year because of scaffolding for parents they knew of my expectations and the kids know of my expectations, they did it, they met the expectations [O, E].

R: How did you communicate with parents.

> T: Sent a parent letter home letting them know that they had been selected and what I would expected [E] and what they would be seeing. I also let them know that I wanted them to help them but not do it for them [E].

R: I have another teacher who said that he thought that that wouldn't be possible so it's interesting to hear you talk about it –

> T: It's definitely possible, we have more say in who comes, as a teacher than you would think. We take the first five but if the fifth one isn't responsible

then it's our responsibility to make sure they make it to slot five and take a different one. Many of the parents who came were volunteers in the classroom.

R: What did you do at school to prepare the students for their field trip? Aprox number of hours?

T: Several things for one we talked about you coming and doing your project [C-pre]. I like to set the stage pretty early, so about a week and a half, I talked about what OMSI looks like and why we are going [C-pre, O]. I set up expectations by talking about what it would look like for a 4th grader going to a OMSI [E]. Talked about OMSI's labs and gave them some examples, so they would get excited before hand [C-pre]. I sat them down and went over expectations the day before complete sentences and what the directions where, in context and how they discovered evidence of solids, liquids and gases [O, or G??].

R: Would you say that they took something they learned in class and apply it to an experience?

T: Absolutely, I think it was also a good Writing experience. We have a school wide writing emphasis so to incorporate that into science is good.

R: How did you expect students to spend their time? Did that happen as you expected?

T: I said I wanted it to be at least half way full but it didn't have to be completely full [O]. I wanted them to be able to float, touch and experience, we had scheduled teachers to go and write a specific scavenger hunt with content questions [G]. Then we thought about it and realized that it would take some of the joy out of seeing the museum, so we changed what we did and made it a little more general while keeping high expectations but it allowed for some diversity in how the kids answered it, it also made it less stressful for the parents who couldn't find the yellow ball that you want the kids to write something about [T, G]. So I think they were able to experience more of the museum at the museum because it wasn't such a specific scavenger hunt.

R: Did you think the field-trip was a success? How did you know this?

T: I saw that the kids, because of the volunteer working in that chemistry lab, I was so impressed to see that were seating down in chem., I think I saw every group that went to the lab [K]. And sit down and engage in it, read all the procedures and do an entire experiment, that was success for me because sometimes they get intimidated but I think OMSI did a good job writing the directions so they were very kid friendly and if they got stuck they either had a parent or the volunteer that could help them out [K].

R: Do you have plans for follow-up at school after the field trip? If so, what are/were they? Aprox. Number of hours?

> T: We came back and we wrote on three by five cards three question., how they felt about the trip to OMSI, what they experienced and a fact they learned [C-post].

R: Did they get feedback on their scavenger hunt?

> T: they did I just graded them and handed them back today, I graded them both for effort and accuracy [K].

R: What resources did you use, if any in planning for your trip?

> T: I did go online and then I talked to the group coordinator and she helped me set everything up [T].

R: Was their interaction with OMSI staff before you're visit? What was the nature of this interaction?

> T: It was great to see so many retired volunteers they seem to be they're there because they really enjoy it.

R: Were there any obstacles in planning your trip?

> T: Um, none that I can think of. I used to direct a summer camp where I planned a lot of field trips activities so this isn't really outside of my activity planning experience.

R: What role does this trip play in your science curriculum? How do you feel about science?

> T: We did it at the end of the unit on matter. We just took the post test. I probably would have done the post test after OMSI, I think that there are still some gap [UP]. I might do a mid assessment and then go on the field trip so that I could guide that learning. For example phenomenon's in matter, such as sound, light. So if I had a lot of time I would go back and address those issues This is my first year teaching forth grade. I think that OMSI will need to fall in the middle so that they have enough background knowledge but I'm not done teaching. Because now they have all this background knowledge.

R: How comfortable are you teaching science?

> T: Honestly it's not one of my biggest level of comfort because I'm new teaching it to forth graders, I've never been to a district science training, there are continuously trying look things up on google and find ways to explain it to

> kids. Although I think it's a pretty good curriculum … I have a really limited science backgroup, I think my kids are at the mercy of my background.

R. What could OMSI do to make the trip a better educational experience for your students?

> T: I thought it was the best one we've been on. It was nice that there weren't very many kids there.

R: Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

> T: Yeah, almost two often. We haven't streamlined it in terms of which grades go to OMSI, everyone goes to omsi whenever they want to go to[H].

R: Do you have anything else you would like to share with me?

> T: That's all I can think. Field trip are very stressful for teachers. I was especially glad that parents didn't encourage kids to. We got lucky on the bus, you have to pass everything off. You don't have direct control over things like that and it can be stressful [H].

R: Thank you so much for your time and for talking to me!

Ms. Ping

R: Would you please give me a short narrative of your schools and class? (3-5 sentences).

T: A third of my class is identified as TAG, 8 of the 24, and this neighborhood is upper middle class. 16% free and reduced lunch, I have three ESL kids in my class, although I have 2 other nationalities represent but they are not Spanish speaking students. Three kids, the Spanish speaking kids, receiving ELL. My class is bringing with them a huge amount of prior experience and this year has been a lot of fun and we did a space unit and one child would ask me a question and I would be thinking I don't know if I know the answer to that and eight other hands would shot up and I would say do you want to answer that and then I would run to google and check and make sure they were sharing a correct one, and they are [A]! So this class has a lot of science background and they love it and they know a lot [A].

R: Do you feel like you met your goals for the field trip to OMSI?

T: I do I feel the mind benders was an exhibit for this particular group, to problem solve and for those TAG kids to stretch their brains and think through those particular problems [G]. The planetarium show just fit in naturally with space unit [CB]. I love that at this age we can put them in small groups w/freedom to choose what they want to do [S].

R: What did you do at school to prepare the students for their field trip? Aprox number of hours?

T: Mostly because it was conclusion celebration of finishing our space unit, the space unit was the preparation [C-pre]. The mind binder was just to let them have some freedom in those problem solving so as for the science it was probably limited to that [LG].

R: How did you expect students to spend their time? Did that happen as you expected?

T: I let the kids choose the groups that they wanted to be in [S]. If one of their parents came then they would be in a group with them and they just formed naturally from there.

R: How did you let them choose their groups?

T: I had them, on a piece of paper, write down the four kids that they wanted to be with. And so I formed the groups around that, sometimes they got all the people they wanted and sometimes, due to the numbers, they didn't but they at least got someone, until the last minute when we had a mass cancelation of parents, which was really stressful and there was a little break down and some

tweaks [S, H]. Ruby was one of those she wasn't supposed to be the only girl in her group.

R: She said she liked it.

T: yes she is very proud of her identification.

R: Did you think the field-trip was a success? How did you know this?

T: Yes, the kids talked about the planetarium show for day after [K]. At first the person who ran the project came and warned me that the movie might be kinda dry and boring [H].

R: Yeah when I was watching that I though this might be pretty challenging material but if you were studying our solar system it would be a good stretch beyond.

T: They would talk about that water planet, and they would have conversations about 'if that water planet would be moved farther out than it would become an ice planet, so they were making those connections [K]. I think they felt that the mind binder mansion was the fun part and the planetarium was the connection to the classroom. The kids seemed very happy.

R: Do you have plans for follow-up at school after the field trip? If so, what are/were they? Aprox. Number of hours?

T: They did journal entries when they came back [C-post].

R: Did you do any other beyond that?

T: Beyond that, no, we discussed the journals the next day and they shared some of those but beyond the journals we didn't do much, I would have done more if it wasn't the end of unit event, but we moved on to the next unit, which was elections [UP?]. I really don't get my class for very much of the day with switching for reading and math [H].

R: What resources did you use, if any in planning for your trip?

T: In the panning I went to teaching planning night and that's where I decided that we would go to OMSI [T]. And then after that evening, the educators evening, I spent some time on the website and used the website for planning [T].

T: What resources did you use when you visited that –

T: That's where I was choosing out the planetarium movies and reading the descriptions and they have some good activities that you can try [T].

R: Was their interaction with OMSI staff before you're visit? What was the nature of this interaction?

> T: It was very good, everyone is supportive and helpful, I called when we had to make the reservation and I was a little panicked, we were a little late getting the money in but no one seemed to harassed me, they seemed to understand. Checking in was a breeze [H].

R: Anything else.

> T: No, it was good.

R: Were there any obstacles in planning your trip?

> T: The only obstacle I ran into was that I wanted to have the fieldtrip sooner so that it alighed better with our unit, but because I went to educators night so late, umm when I wanted to have it, it wasn't possible because they wanted the money collected in two days and that would have been impossible to do because I just need wouldn't have been possible because I just need a little bit of time, so the only thing I was disappointed is that we had to wait so long to go, because we had to wait to get all that money collected and the deposits and their time lines, [CB, G, H, UP].

R: So you had been done with the unit –

> T: Yeah for a few weeks, and I think part of that was that I called two weeks before I wanted to go, but we had to stretch it out for a month [H].

R: What could OMSI do to make the trip a better educational experience for your students?

> T: Hmmm- Over all it was such a positive experience. Like I said, the only thing is that I wish I could have had the field trip sooner, but I understand, I understand why they have to have weeks between thing [H].

R: Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

> T: Not sure. I'm new to this grade and everyone who taught fifth grade did not return. I used to teach first grade and I took my students but it's been years since I've been, maybe four.

R: Do you have anything else you would like to share with me? How did that go, I know that was really stressful with the parents not showing up, did you feel like your day got thrown off?

T: Just made the morning, some of discussion and prep that I would have like to do, get cute short because I had to have them work quietly [UP]. My original plan was to really talk about the different exhibits that were there and have them make a plan for what they were going to see, first second then [UP].

R: so you would have…

T: Right, I would tell them 'these are some of the things that are available for you to see at OMSI and kinda give them a summary of the exhibits and as a group do some planning as a group of the top things they wanted to see and make a plan [UP].

R: Thank you so much for talking to me.

Ms. Shull

R: Would you please give me a short narrative of your schools and class? (3-5 sentences).

T: We have about – 9% special education, 28% ESL and um 35% free and reduced lunch for our overall school. And then native American might be 1%, that's probably good.

R: Is the neighborhood supportive, it seems like you have a lot of volunteers?

T: We get a lot of volunteers, it's kind of, we have high and and low socio-economic so it's a weird mix. We have a lot of help, we have a lot of parents helping us, we also have a lot of need.

R: Do you feel like you met your goals for the field trip to OMSI? Yeah, what were some of the goals?

T: We wanted to give them a visual experience of the moon, they've been viewing the NW skies nightly for the last month, so seeing it drawn out in the planetarium show it brought it to life and connected to curriculum [O, CB, G].

R: Did you just get done with a unit or where you in the middle –

T: We were done, we had watched the moon phases for a month we had been doing art work and we had a solar system unit. Our whole unit was around the solar system and the moon, so this trip was a culmination event [CB, G].

R: What did you do at school to prepare the students for their field trip? Aprox number of hours?

T: We talked about what the OMNImax is and we had the preview materials were that we got some preview material that OMSI emailed to us [C-pre]. We talked about the planetarium [C-pre].

R: So OMSI emailed you material what did that look like

T: What you should do at OMSI and vocabulary what to expect from the movie [C-pre].

R: Approximately when did you do that, day before --?

T: It was a Monday so it was about a week before we went over that, seating rules the basics of being on a fieldtrip [E]. Preview material we went over about two weeks before, but our whole unit was about a month before [C-pre, O].

R: What was your thinking on that?

T: We get the basics, so like who they will be with and where they will go just before [E], as far as the preview material we wanted to go over vocabulary and make sure they had that background [G], we usually have them write about their experience on the field trip as kinda of a reflection [C-Post].

R: Did you do that this year?

T: Yeah we do writing in there journal off and one and in their writing class I think they did some writing about the fieldtrip [C-Post].

R: Do you have plans for follow-up at school after the field trip? If so, what are/were they? Aprox. Number of hours?

T: It was sort of the end but I would say another two hours were spent, we are sort of putting together our moon and solar system folder. We are still following up a bit We might have a final test or gathering up some final materials [C-Post].

R: Were there any obstacles in planning your trip?

T: It seemed this year that OMSI had decided to, in previous years they had a deposit a certain amount of time before the field trip, they wanted to get the money two weeks after we scheduled the field trip. Parents and PTOs don't want to get the money way in advanced. "monitary strain, I hadn't even met the kids or parents, I was like sure you can get the money in two weeks, they are restricting the money to what is hard in a school situation. I have to get the bus way in advance. The set up this year in collecting and getting the money in

advance was a hardship. I was hoping it would all work out and not get charged to me because I was taking that risk [H].

R: How comfortable are you teaching science?

T: Fine very comfortable. Hands on, from the book, reading text, fine.

R: How would you describe the range of science attitudes in your class?

T: Um, pretty wide, it's non fiction text that you use along with the subject. I think with the solar system there is not as much hands on as if you are doing matter or energy. If they are having to read your more dryer text they might get lost in it, it might be more difficult to navigate at a fifth grade level than say a story. The range they might be board with the text, or they might love it and science is their thing. Science, non-fiction text is a much more difficult things to navigate for the struggling readers than a story but they might love the hands on. So you get the range [A].

R: What could OMSI do to make the trip a better educational experience for your students?

T: In general things run pretty well. I always get the stuff ahead of time. It seems pretty streamline as to where you go.

R: Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

S: Because we are doing it fifth grade it's been tired to that curriculum [CB]. I wouldn't say that ever fifth grade student has been to OMSI but me and my teaching partner, we have done that because it is one of the things around here that ties into the solar system [CB].

R: Do you have anything else you would like to share with me? [shakes head] Well, thank you for your time and for letting me work with your class.

Mr. Wiley

R: Would you please give me a short narrative of your schools and class? (3-5 sentences).

T: At the school, gosh, they can tell you probably at the office, Pretty diverse. There is only one pulled out for IEP and 4 receiving ELL, one Spanish three Russian.

R: Do you feel like you met your goals for the field trip to OMSI?

T: Yes, although I probably should do some follow up I haven't done any follow up [LG, UP]. It's bad to do it on Friday no opportunity for follow. It's hard to do the follow up when it's on Friday [H]. It was what was available.

R: And you like to do it this time of year, why?

T: Inspire them in science get them revved up [G].

R: What did you do at school to prepare the students for their field trip? Aprox number of hours?

T: We read about Lewis and Clark [C-pre].

R: How did you expect students to spend their time? Did that happen as you expected?

T: Exploring, trying things, asking questions but I don't know if they do that much [LG]. There isn't time to go over all the things that you want with parents [UP]. It would be nice to have more time to do that [H]. It would be great to go back, but I only go once you know $10 bucks a shot [H].

R: Did you think the field-trip was a success? How did you know this?

T: I believe it was, more from observation, I didn't test them, there just isn't much time, you did that so we will find out ha ha ha [K, LG].

R: What resources did you use, if any in planning for your trip?

T: I don't believe I used any. I know about the movie so –

R: Were there any obstacles in planning your trip?

T: Financial can be, it was a factor [H].

R: Where did the funding come from?

T: Parental contribution and PTO.

R: What role does this trip play in your science curriculum? I know we talked about this, integration into your curriculum included Lewis and Clark and, introductions to scientific investigations, is that correct? [CB].

T: I will do some writing follow. I would usually do it the next day but I wasn't able to this year [UP].

R: How comfortable are you teaching science?

T: Not very, I wish it was my favorite subject, I have always said that I wish it was my favorite subject, I wish I could teach more of, but it's just so hart to put stuff together for it, that it just doesn't happen [A].

R: Why do you think it's something you wish you could teach more of?

T: It would so exciting and its across the curriculum, you can teach math, you can teach reading you would be able to do writing, you would have there attention and it would be hands on and you could teach everything [A].

R: How would you describe the range of science attitudes in your class?

T: Not a big range, because they all seem to like it [A].

R: So mostly good enthusiasm?

T: yeah.

R: What could OMSI do to make the trip a better educational experience for your students?

T: It's really more time they do a good job. The lunches are great. No wasted time compared to James and the giant peach [a recent field trip of theirs] you sit down they start the movie, it's not bad at all.

R: Does your school regularly go to OMSI? If not, have your students most likely been to OMSI before?

T: Yes, this is the first time that only one class has gone.

R: Do you have anything else you would like to share with me?

T: Nope, sorry I can't think of that.

Appendix L. Open coding procedure

Teacher Interview Codes

- G – evidence is seen that the teacher has clear goals for his or her fieldtrip to OMSI
- LG – evidence is seen that the teacher does not have goals that can clearly be articulated for his or her fieldtrip to OMSI
- O – Objectives are clearly communicated to students or parents.
- S – evidence of structured experience
- T – teacher planning or preparation
- C-pre – classroom pre-orientation
- C-pro – classroom fieldtrip follow up
- ST – standards addressed with fieldtrip
- CB – explicit ties to curriculum
- E – expectations clearly communicated to students or parents
- H – hurtles or teacher related obstacles
- UP – unmet plans or goals (the teacher may talk about what they had wanted to do or what they know they should do differently next time).
- K – how did teacher know that there goals were met or that the students were learning, what did they see or do.
- A – attitude toward science discussed

Student Interview Codes

- O – Student shows evidence of understanding of the field trip objectives.
- E – Student demonstrates understanding of teacher expectations
- S – evidence of structured experience
- CC - Choice and control
- CB – Student show understanding of how the field trip explicit ties to curriculum
- C-pre – student discusses classroom pre-orientation
- C-pro – student discusses classroom fieldtrip follow up
- OPS - Orientation to the physical space
- P - Prior knowledge and experience
- A – attitude toward science discussed
- L – evidence of student learning
- GSM - Within-group social mediation
- F - Facilitated mediation by others (Teacher, Parent other OMSI Staff).
- FE – Fun or enjoyment expressed

- D – Discomfort or disappointment

* Some student codes taken from Falk and Storksdieck “Eleven key factors that influence learning from Museums.”