

"CATCH OF THE DAY":
A CASE STUDY OF CHILDREN'S PERCEPTIONS OF FISHING

By

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ABSTRACT

“Catch of the Day” is an ethnographic case study of children’s perceptions, experiences, and explorations, as well as their learning, in the informal social context of recreational fishing. The intent of the study was to observe what the children experienced and explored, analyze how they shared their experiences with the other participants, interpret their explanations and extensions, and determine their perceptions of their fishing experience.

Constructivism and situated cognition provided a theoretical perspective for the study that was congruent with the naturalistic inquiry research design and methods used. Small groups of children were videotaped as they fished off a marine float and interviewed after they had reviewed their video. Observations focused specifically on the children’s verbal and non-verbal behaviours as they interacted with their social and physical environment. Transcriptions provided a database for the construction of individual “Fish Tales,” vignettes of the fishing experience from the child’s point of view. The interpretive commentaries highlight salient details from the researcher’s perspective as a participant observer on the site. Examples of the children’s levels of engagement in learning are listed under Feher’s (1990) categories (Experience, Explore, Explain, Extend) so that comparisons can be made among the children.

The findings showed an increasing differentiation in the children’s levels of engagement, from universal sensory and perceptual experiences to unique examples of abstract cognition (explanations and extensions). The children’s drawings revealed misconceptions in marine ecology that would otherwise have gone unnoticed. The findings also revealed a range of children’s perceptions, and these affected not only what the children learned but also how the children learned and acted at the site. Authentic science experiences such as fishing promote children’s engagement in collaborative problem solving and learning in marine education and have the potential to reduce the gap between classroom learning and cognition in practice.

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Forward

In judging the quality of case study reports, Lincoln and Guba (1990) argue that

The writing should demonstrate the intellectual wrestling that the writer went through in coming to his/her conclusions. It should display courage. The construction should be extended beyond "safe" limits. It should display a certain element of risk-taking, of putting the writer's ego on the line, of invitation to criticism (p. 56).

In writing the "Catch of the Day" case study I came to realize that I was wrestling intellectually with the dilemma of using my own "voice" in my research. The more immersed I became in my personal writing and interpretations for the Fish Tales and Discussion chapter, the more I became aware of the dissonance I had created by writing the first four chapters in a detached third person singular voice. I felt I needed to have courage and go beyond "safe" limits and take risks by rewriting these chapters for consonance with my beliefs and assumptions about naturalistic inquiry methods.

The lobster's dilemma is a metaphor that expresses the tension I felt. The lobster takes the initiative in risking growth. In order for a lobster to grow it must shed its hard external carapace, wrestling with the shell to break free, thus allowing the underlying softer layer to expand and soon harden. Surrounded with environmental stress the lobster is vulnerable and must take risks in order to continue to grow, risks that invite predation. Then again, it outgrows its tight, restraining, confining mold and wriggles free with a more flexible carapace. With each shedding, the lobster risks growth.

Stress, vulnerability, risk-taking—such is the dilemma of the lobster. In my journey of life-long learning I have sometimes felt like the lobster, risking growth surrounded with environmental stress. With the shedding of each mold I have experienced a vitally invigorating stretch, and the experience of each shedding lives on in future sheddings. When learners—children, teachers, and researchers such as myself—shed limiting perspectives, they grow also. Risk-taking in exploring a pedagogy which is new to teachers, such as constructivism and situated cognition, is stressful yet generates positive consequences. A learning environment of open discussions, collaboration, interaction,

mutual trust, and intellectual respect develops the self-esteem of all learners so that they too can grow in their learning. Risk taking, in presenting my "Catch of the Day" research with my own "voice" rather than generating distance and stressing impersonal detachment through "self-obscuring" (Gouldner, 1970) methodologies, is to affirm my own autonomy with a vitally invigorating stretch. Gouldner believes that

To affirm the value of autonomy is to insist that the story the sociologist tells be his own story, that it be an account in which *he* truly believes and to which *he* commits himself. Autonomy is an insistence upon authenticity. It says that if a man can never tell the 'whole truth', then at least he should strive to tell his own truth" (p.59).

The "Catch of the Day" presents my story of the children's fishing stories and experiences.

CHAPTER 1: INTRODUCTION

Tell me, and I'll forget;
Show me, and I may remember;
Involve me, and I'll understand.
 proverb

The Problem

The main task of science educators is to help children understand and use science concepts and principles underlying phenomena. However, there is a general concern among educators that science continues to be presented in classrooms as the transfer of decontextualized knowledge. Traditional teaching methods are not congruent with current research on learning. Driver and Oldham (1986) claim that didactic teaching methods still tend to predominate especially in upper secondary classes. Their intention was to develop revised teaching approaches which would be informed by research on children's thinking in science and current theoretical developments in cognition. Resnick (1987) suggests that schooling should be reorganized to take account of what we are learning about the nature of competence in our lives. Hennessy (1993) believes that the disjunction between classroom learning and cognition in practice is a key issue that has important implications for classroom learning and pedagogy.

Brown, Collins, and Duguid (1989) are also concerned with the ineffectiveness of traditional teaching practices that focus on the unilateral transfer of decontextualized knowledge. They suggest that "the breach between learning and use, between knowing what and knowing how, may be a product of the structure and practices of our education system" (p. 32). As a result of such teaching practices, many children view school science as unconnected with their daily lives and as a difficult subject to be avoided. Educators are concerned that the initial wonder and excitement that young children instinctively bring to learning settings and their inquisitive curiosity which motivates them to learn about natural phenomena are often stifled by the time children enter intermediate grades. Thus, many educators believe that positive attitudes towards science learning must be nurtured in the

children's early years in order for them to develop scientific literacy. Changing the way science is presented to children requires a reappraisal of assumptions about learning that underlie current teaching practices.

Current research suggests that learning is not just a personal and cognitive experience of individuals, but it is also a social, emotional, and cultural experience shared by groups (Csikszentimahalyi, 1987; Shapiro, 1994; Wells, 1986; Cobb, 1994; Hennessy, 1993; Bateson, 1994). Such understandings help define the role of the teacher in the science classroom, particularly in the creation of effective learning environments and in the provision of authentic science experiences that promote children's engagement in collaborative learning. Understanding what children collectively bring to new learning situations is fundamental to accomplishing these goals. Also, Resnick (1987) suggests "there is a general need to redirect the focus of schooling to encompass more of the features of successful out-of-school functioning" (p. 19). She urges

a redirection of educational efforts that goes beyond the individualist vision of current classroom learning models, to one that draws on models of shared intellectual functioning such as we see in our best work environments (p. 19).

Delamont (1989) argues that "the time is ripe for a major research initiative in the sociology of science education" (p. 26). She points out a lack of research on learning environments, specifically learning environments in science and on socialization into science. Thus, new directions for educational research and science teaching in the areas of informal approaches to learning in social contexts are needed to provide insights into the creation of authentic learning environments and experiences within the regular classroom.

The Problem Statement

Prior research studies on children's learning in informal settings such as museums and science centres (Carlisle, 1985; Feher & Rice, 1985; Lucas & McManus, 1986; Falk, Koran, & Dierking, 1986; Diamond, 1986; Feher, 1990; Busque, 1991; Falk, 1991; McManus, 1992) focused on how learning occurs in these environments, how learning can

be enhanced, and what children learned from their experiences. Feher's (1990) belief that people learn by doing, playfully interacting with exhibits, reflects Dewey's (1938) notion of learning by doing. Falk (1991) believes that paying attention is the first step in any learning sequence, and Csikszentimahalyi (1987) goes further to state that learning involves the whole person: the senses, desires, longings, feelings, and motivation. These researchers concluded that the free choice context of an exhibit, opportunities for active exploration, and social interactions are important factors in promoting learning. Their findings are significant as they suggest implications for educators in determining the kinds of settings that enhance collaborative and individual learning and those experiences that move children beyond "Gee-Whiz!" thrills to "Aha!" understandings.

A review of the literature on learning in informal settings revealed a set of interrelated questions that guided the researchers' investigations. These broad questions are relevant to the present study: How do children learn in informal social settings? How important is social interaction in learning? How do children perceive their learning? Do children gain scientific understandings through social behaviours and interactions as well as physical manipulations? Can educators facilitate learning through inquiry by providing opportunities for children within a social context to experience phenomena and explore through child-centered, open-ended investigations? What implications can be drawn for the teaching and learning of science in regular classrooms that will help to close the gap between schooling and everyday practice by children?

Reflecting on these foreshadowed questions helped me to determine the educational context of the present study: informal approaches to learning, science education in authentic social contexts, and implications suggested by the study's findings for teaching and learning in the regular classroom. Within this educational context, I restricted the scope of the study to two aspects of interest: children's perceptions of fishing and how children share their experiences. Brown, Collins, and Duguid (1989) argue that the perceptions resulting from

an activity, such as the fishing event in the present study, are a central feature in both learning and activity. Brown, Collins, and Duguid (1989) believe that

How a person perceives an activity may be determined by tools and their appropriated use. *What* they perceive, however, contributes to *how* they act and learn (p. 36).

Overview Of The Study

“Catch of the Day” is a case study of children’s perceptions, experiences, and explorations, as well as their learning, in the informal social context of recreational fishing off a marine float. I conducted the study as a participant observer among groups of three, four, and five children engaged in learning how to catch fish. I selected twenty-one boys and girls between the ages of 6 and 14 years from one school district. The children expressed interest in learning how to catch fish and in explaining their thinking with each other and with adults. My observations focused specifically on the children’s verbal interactions and non-verbal behaviours as they interacted with their social and physical environment. I presented the data that I collected through personal observations, videotape recordings made by an assistant, and informal conversational interviews with the children as a collection of narrative vignettes, “Fish Tales,” followed by my interpretive commentaries. I wrote three individual Fish Tales, one for each of the children in one group, to present what the children experienced and explored in the study and to represent the children’s perceptions of the fishing experience.

Theoretical Perspective For The Study

Gouldner (1970) describes a researcher’s set of beliefs or background assumptions as “silent partners” in the theoretical enterprise. He believes that

Background assumptions provide some of the bases for choice and the invisible cement for linking together postulations. From beginning to end, they influence a theory’s formulation and the research to which it leads....Theories are accepted or rejected because of the background assumptions embedded in them (p. 29).

The theoretical perspectives of constructivism, situated cognition, and naturalistic inquiry provided a basis for the research design of the present case study because the background assumptions embedded in them are compatible with my assumptions about learning, particularly children's learning in an informal, social, and recreational context such as fishing. Gouldner (1970) believes that

The theory felt to be intuitively convincing is commonly experienced as *déjà vu*, as something previously known or already suspected. It is congenial because it confirms or complements an assumption already held by the respondent.... It "sensitizes" the viewer (p. 30).

Constructivism is a set of beliefs about knowing and knowledge that suggests that learning is a social process of making sense of experience in terms of what is already known to the learner. In Driver's (1987) view, the central premise in a constructivist approach to learning is that knowledge is a human construction:

A key feature in this perspective is that human beings construct mental models of their environment and new experiences are interpreted and understood in relation to existing mental models or schemes.... Perception is the construction of a model of the world (p. 133).

The view of the learner as architect of his/her own knowledge is a broadly held assumption in the constructivist paradigm, an assumption that becomes a "silent partner," "sensitizing" my perceptions and interpretations.

Driver lists other features characteristic of the constructivist perspective which have significant implications for teaching and learning, as well as the qualitative design of the present case study:

- Learners bring their prior conceptions to learning situations.
- Learning is an active process on the part of the learner. The construction of meaning often takes place through interpersonal negotiation.
- Knowledge is not 'out there' but is personally and socially constructed.
- Teachers also bring their prior conceptions to learning situations not only in terms of their subject knowledge but also their views of teaching and learning. These can influence their way of interacting in classrooms.
- Teaching is not the transmission of knowledge but involves the organization of situations in the classroom and the design of tasks in a way which promotes scientific learning.
- The curriculum is not that which is to be learned but a program of learning tasks, materials, and resources from which students construct their knowledge (p. 138).

These constructivist assumptions also become my silent partners sensitizing me, the researcher, in choosing consonant research methods. Tobin (1993) believes that the constructivist perspective opens the doors for qualitative research methods such as the naturalistic inquiry I used in the "Catch of the Day" case study. Tobin urges researchers to move beyond the need for certainty in their research and celebrate the existence of ambiguities:

Since constructivism acknowledges the impossibility of ever knowing the truth, it is possible to alter the metaphor of researcher as truth-seeker to one of researcher as learner. The role of the researcher is to make personal sense of experience and, in a socially mediated way, to build knowledge in a given field (p. 15).

From a constructivist point of view, the emphasis is on the researcher as learner as well as participant observer, one who constructs personal meaning of the shared fishing experiences through critical reflection as well as observations, and by doing so builds knowledge in the field of learning in informal social contexts.

In naturalistic inquiry, context is heavily implicated in meaning (Lincoln & Guba, 1985). Hennessy (1993), arguing from the theoretical perspective of situated cognition and cognitive apprenticeship, also believes that meaning is influenced by context, specifically,

the social and cultural context in which problem solving takes place, including the physical setting, the purpose of the activity, the existence of collaborating partners, and the social milieu in which the problem is embedded (p. 1).

The "everyday" or "situated" context is characteristic of the situated cognition theoretical perspective, and "situated" also describes the context of fishing. Hennessy explains that in the situated cognition view learning is a process of

enculturation or individual participation in socially organized practices, through which specialized local knowledge, rituals, practices, and vocabulary are developed...Knowledge moves from being private to being shared through engagement in socially shared activity and discourse (p. 2).

She points out that in real-life problem solving "a situation becomes a problem in the course of activity in a particular setting, and uncertainty, flexibility, improvisation, contingency, and adaptation are characteristic" (p. 30). The problems encountered are authentic and relevant to the learner rather than artificially constructed. Hennessy (1993) believes that

a critical insight derived from the situated cognition research is that

Problems emerge out of dilemmas and learning arises when means are sought to resolve those dilemmas...We must recognize that 'emergent problems' will arise while students carry out complex tasks in a rich problem-solving context (p. 33).

Fishing off a float with friends offers a rich problem-solving context where problems emerge out of dilemmas.

Cobb (1994) believes that the constructivist and sociocultural (situated cognition) perspectives are complementary:

The sociocultural perspective informs theories of the conditions for the possibility of learning, whereas theories developed from the constructivist perspective focus on what students learn and the processes by which they do so...Learning should be viewed as both a process of active individual construction and a process of enculturation into the practices of wider society (p. 13).

The theoretical perspectives of constructivism and situated cognition are also congruent with the methodology and purposes of naturalistic inquiry. Gouldner (1970) argues that every research method makes some assumptions about how information may be secured from people and what may be done with people, or to them, in order to secure it. In naturalistic inquiry, the assumption is that people are not "things" to be controlled or manipulated by the experimenter but are unique individuals who choose to share their experiences and perceptions in a variety of ways.

The basic assumptions of the naturalistic paradigm are congruent with the constructivist perspective. Lincoln and Guba (1990) argue that "any case study is a construction itself, a product of interaction between person, character, experience, context, and philosophy of the constructor" (p. 54). They believe that the quality of a case study rests on the following criteria:

- The case study report must reflect the multiple realities constructed by the respondents in the inquiry.
- It must demonstrate in what ways it has taken account of the mutual shaping of phenomenal elements in that site.
- It relies on "pattern theories" rather than "a priori" theories.
- It rejects generalizability and the drawing of nomothetic conclusions.
- It takes account of the value influences that impinge on the inquiry (values which dictate the choice of problem, theoretical framework, paradigm, and researcher).

- It reflects the investigator's involvement in such a way as to make clear that objectivity is not an aim.
- Its methodological treatment comprises reflections on the investigator's own personal experience of the fieldwork (p. 54).

It is also important in naturalistic inquiry to allow the focus of the study to emerge and change as data are generated and interpreted. Thus, naturalistic inquiry methods allow research questions to be clarified during a study.

The "Catch of the Day" case study rests on a theoretical foundation of basic assumptions about learning and inquiry in social contexts. Lincoln and Guba's (1990) criteria for quality case study reporting are summarized as follows:

- The case study will resonate with the belief system of the alternative paradigm.
- The case study will rhetorically exemplify the interpersonal involvement which characterized that form of inquiry, making the reader an interactive partner with the writer in reaching understandings and drawing implications (p. 58).

The present case study "Catch of the Day" endeavours to resonate with the belief systems of three alternative paradigms: constructivism, situated cognition, and naturalistic inquiry. From the naturalistic inquiry methods inferences can be made about the relationship between perceptions, learning, and problem-solving experiences in authentic contexts such as the present study's small group fishing activity.

Research Questions

With the theoretical perspectives of constructivism and situated cognition serving as a framework, I addressed the following research questions in this qualitative study:

1. What did the children experience and explore?
2. How did the children share their experiences?
3. What were the children's perceptions of fishing?

The research is a case study of small groups of children learning how to catch fish off a marine float. I present a holistic view of the children's experiences, explorations, explanations, and extensions of learning, but I also explore in depth three of the children's

perceptions of fishing and ways they shared their fishing experiences with the other participants.

Significance Of The Study

Learning how to catch fish in a social, recreational context can be used as a vehicle in marine education curriculum and as a strategy that can have significant implications for the teaching and learning of science in the regular classroom. As Tobin (1993) points out,

The recognition that knowledge has both individual and social components that cannot be meaningfully separated enables us to construct science learning environments where multiple ways of knowing are sought and valued (p. 6).

Thus, the present study will be useful to educators in determining the kinds of social interactions that enhance collaborative as well as individual learning in science. The study will also be useful to educators in considering how individual children's perceptions, together with their prior knowledge and experiences, affect how they act and learn.

I could not find any previous studies of children's experiences, explorations, or perceptions of fishing in the literature.

Boundaries Of The Study

This case study of small groups of children learning how to fish in a social, recreational context is exploratory research in which I sought to understand the individual participants' perceptions of their fishing experience. I used naturalistic inquiry, seeking to answer the fundamental question: What can be learned from this particular case? As the contextually-rich setting of this study is important, my research does not attempt to generate grand theories from the data I collected. Instead, I endeavoured to understand the idiographic meanings each participant derived from the fishing experience and how these meanings were shared with the other participants including me, the researcher and fellow fisher.

The participants I chose for the study are not representative of any population, as there really isn't a true "representation" of a population in qualitative research such as the "Catch of the Day" study. The heterogeneity of the groups brought richness rather than limits to the study as the multiplicity of perceptions offered me many avenues for interpretive research. Rather than represent the range of participants' experiences and perceptions of fishing in twenty-one separate vignettes, I limited the presentation of data to three "Fish Tales," one from each of the children in one fishing group in the study. However, a range of children's perceptions of the fishing experience is apparent within the one small group. In the discussion, I compared and contrasted the three children's perceptions and experiences with the perceptions and experiences of the other participants in the study.

The variety of fishing equipment and resources that I made available to the children, the location of the research site and its unique characteristics, and the time of day and the season of the year provided both opportunities and limits on what the children could do and learn. Because of the confined space and the number of participants on the small marine float, I made only one long casting rod and spinning reel available to the children. However, this limitation provided opportunities for the children to experience another method of fishing besides "mooching" with a simple fishing rod and reel, to learn new fishing skills, and to compare the effectiveness of each method in catching the kind of fish commonly found beneath the float. Because I invited the children to fish during late summer days when perch are abundant beneath marine floats, they had many opportunities to see and to catch fish. However, providing opportunities for successful fishing experiences in only one "harvest" season has the potential to limit the children's understanding of the seasonal nature of fishing.

The "Catch of the Day" case study originates from my personal interest and involvement in recreational fishing with children, as well as my professional development

in outdoor environmental education and marine biology for teachers. To some extent, my presence in the study and profession as a science teacher impinge on the children's exercising of free-choice, as, for example, when I gave reminders to the excited children not to run on the ramp and float. As a result, my presence as a participant observer, as well as the fishing equipment chosen for the study and the float site, had the potential to influence the children's experiences, explorations, and perceptions of fishing.

Fishing Terms Used In The Study

A glossary of specific fishing terms I used in the "Catch of the Day" case study (e.g.: buzz-bomb lure, casting, leader, mooching, salmon hook-up, snag, steak, still fishing, treble hook) appears in Appendix A. The glossary also includes a sketch of a buzz-bomb lure and a salmon hook-up (also called a herring hook-up).

CHAPTER 2: LITERATURE REVIEW

Mooching for salmon is increasing in popularity and will continue to do so because it is an engagement which utterly captivates the participant...Mooching is a personal sport. You have to watch your rod tip carefully, then apply...the little techniques necessary to hook the salmon when the rod tip has signaled the presence of the fish. Although many salmon hook themselves, the experienced moocher can greatly improve his chances of success by applying himself to the sport....Because mooching requires a minimum of muscle and a maximum of concentration and skill, it is attracting more and more women. Anyone can learn the basic techniques, and once mastered, it then becomes a matter of adding to your fund of knowledge, using a little intuition and having a little luck!...Mooching is a highly developed art with a variety of tricks and techniques.

Nuttall (1980, p. 9)

Introduction

“Catch of the Day” is a case study of children’s perceptions of their fishing experiences. The authentic social and recreational context of group fishing off a marine float defines the study as research in the broad field of informal learning environments and approaches to learning. In a review of the literature I focused specifically on a search of children’s learning in informal social contexts. Relevant studies in this review included research in naturalistic inquiry, experiential learning, marine education, constructivism, and situated cognition.

Many researchers have explored the conditions conducive to effective learning in informal environments such as museums and science centers (Carlisle, 1985; Feher & Rice, 1985; Lucas & McManus, 1986; Diamond, 1986; Falk, Koran, & Dierking, 1986; Csiksentimahalyi, 1987; Feher, 1990; Falk, 1991; Busque, 1991; McManus, 1992; Tuckey, 1992). Some of these researchers have observed visitors in order to understand how the social context of the exhibits influences behaviour as well as learning.

However in conducting a review of the relevant literature I noticed a gap in this body of knowledgeable research. The writers of some journal articles (Matthews, 1994; McLure, 1993) suggest that children could learn about bait types, fishing equipment, and aquatic ecosystems from an outdoor fishing experience. Schmidt (1991) urges educators to promote family communication and involvement in this positive recreational pursuit so that

children can become “hooked on fishing, not on drugs” (p. v). Lucas (1983) lists sources of informal approaches to learning that have the potential to contribute to scientific literacy: “Hobby activities, such as angling,...can provoke science learning” (p. 27). However, Lucas points out that the learning potential of such hobbies has not been explored. In a review of the literature, I could not find any research studies that investigated children’s learning or perceptions in the social context of recreational fishing off a marine float. Thus, the “Catch of the Day” case study presents new possibilities for qualitative research in a very ancient social activity.

A second body of theoretical and conceptual literature provided a foundation for an understanding of learning in informal settings and thus shaped the qualitative design of the present study. This literature includes the philosophy of constructivism (Driver, 1987; Gunstone, 1987; Tobin, 1993), naturalistic inquiry (Lincoln & Guba, 1985), and situated cognition (Resnick, 1987; Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Cobb, 1994). A review of this literature helped me to define the theoretical and conceptual framework of the present study. I used the theoretical perspective of naturalistic inquiry, as described by Lincoln and Guba, to design the case study, to focus my initial observations, to analyze emerging perceptions, and to formulate tentative inferences and interpretations.

The literature review begins with a definition of what is meant by the expression “informal learning” and then gives a synthesis of the research on informal learning environments, the criteria for effective exhibits, and the influence of a social context on learning-related behaviour. A review of research on learning from a constructivist perspective provides insights on how meaning is constructed and used in problem-solving situations. Research and theoretical literature in the area of situated cognition focuses on the relationship between learning, perception, and social contexts. Situated cognition theorists such as Lave and Wenger (1991), who believe that learning results from participation in actual cultural practices, push the notion of informal hands-on inquiry into the dimension of authentic experiences. A review of the research on the concept of

“storying,” the construction of meaning in authentic contexts (Wells, 1986), completes the literature review for the “Catch of the Day” case study.

Perspectives On Informal Learning

What is “informal” learning?

In a review of the literature I noticed that researchers often use the phrase “informal learning.” For example, Falk (1991) discusses “institutions of informal education,...free-choice environment of informal education (p. 267),...informal learning setting” (p. 268), and “informal science educators” (p. 274). Lucas (1983) describes “potential sources of informal science learning” (p. 4) and comments on “informal learning and its interaction with school science learning” (p. 1). Tuckey’s (1992) research investigated “children’s informal learning at an interactive science center” (p. 273). Lucas and McManus (1986) assert that “the context of informal learning must be preserved if the results are to have validity” (p. 344). Price and Hein (1991) stress the “importance of informal science experiences” (p. 505), while Csikszentimahalyi (1987) shares his insights on “informal learning settings” (p. 80). More recently, Hennessy (1993) describes “mechanisms of informal learning” (p. 4).

However, not all researchers clarify what they mean when they use the expression “informal learning.” There is an assumption that the adjective “informal” modifying “learning” is not used to indicate a kind of learning but rather an approach to, and an environment for, learning. McManus (1992), seeking to clarify the expression, asks, “What is informal education?” (p. 165). She believes that an understanding of this term rests largely on a perceived contrast between

the approaches taken by formal educationists to their students and the approaches museum professionals need to devise in order to cater for their audiences. In formal educational situations, where you learn, who you will learn with, whether you are qualified to learn, who you will learn from, what you will learn, how long you will be given to learn it, agreement on what you have learned, and your level of understanding are matters largely out of the control of the individual learner (p. 165).

McManus (1992) contrasts informal education simply by stating that “it is entirely free choice in every respect” (p. 166). Hence, the phrase “informal learning” is generally meant to be descriptive of informal approaches to learning and learning in informal environments such as science centers and museums as opposed to “formal” learning, meaning schooling that has traditional, structured approaches to learning. In the “Catch of the Day” case study, I use the expression “informal learning” to describe children’s learning in an authentic, social context of recreational fishing with friends.

Common themes in research on informal learning

Many researchers have investigated learning-related behaviour in informal environments such as museums and science centers. In a review of the literature I noticed that three research questions were common themes in these studies:

- (1) What are the features of informal environments that are conducive to learning?
- (2) What are the features of effective exhibits?
- (3) How does the social context influence visitors’ behaviour and learning?

The researchers have designed their studies to seek answers to these three questions and their findings have revealed the characteristics of learning in informal settings and the importance of a social context for learning. In the following section I reviewed the literature on informal learning with the purpose of summarizing the pattern of findings for each of these three research questions. The findings are relevant to the present “Catch of the Day” case study as they provide analogies for understanding and interpreting the social and physical interactions that I observed in the authentic context of recreational fishing. The research findings on learning in informal environments and social contexts also provided me with insights for the design and interpretation of the present study.

(1) What are the features of informal environments that are conducive to learning?

Many researchers have argued that informal environments and informal teaching approaches are more effective in promoting learning than traditional teaching methods in

formal settings such as schools. Resnick (1987) contrasted learning in school and out in order to provide an understanding of the conditions that make informal settings more effective in promoting learning. I summarized the conditions identified by Resnick as well as conditions identified by other researchers and presented these in Table 1 as a list of some of the characteristics of “formal” and “informal” approaches to learning. Since some school environments and approaches to learning have elements that Resnick and other researchers would describe as “informal,” the chart should be regarded as a convenient way to distinguish between the extreme characteristics of “formal” and “informal” approaches to learning (i.e.: “formal” representing a highly structured, teacher-centered, traditional approach to schooling, and “informal” representing a learner-centered view of education). An understanding of these contrasting characteristics is relevant to the present study since the perceptions children acquire about fishing and marine ecosystems in an “authentic” social and recreational context could differ significantly from their perceptions and learning in marine education within a formal school environment. I discuss Resnick’s views on the contrast between cognitive activity in school and out in greater detail later in this chapter in the section on situated cognition.

Falk, Koran, and Dierking (1986) assessed the learning potential of science museums for enhancing scientific literacy. Like Resnick (1987), these researchers list a number of dimensions in which museum learning is distinct from school learning, ones that add to the contrasts presented in Table 1, and they believe that these features describe an effective informal learning environment:

- It is a free choice setting (with respect to involvement/noninvolvement, and attendance/nonattendance) where children establish their own goals.
- It is nonevaluative and noncompetitive. (Evaluation and competition, when present, are the result of intrinsically, rather than extrinsically, imposed criteria.)
- It provides contextually relevant learning opportunities.
- It involves a heterogeneous grouping of children (with regard to age, social background, and motivation).
- It is a social setting that encourages group learning (p. 505).

Table 1

Some Characteristics Of "Formal" And "Informal" Approaches To Learning

<u>"Formal" Approaches To Learning</u>	<u>"Informal" Approaches To Learning</u>
<ul style="list-style-type: none"> • teacher-centered activity • teacher establishes predetermined goals • competitive environment and goals • assessment and evaluation stressed • individual achievement valued • decontextualized learning activities and lessons, often irrelevant to learner • extrinsic motivation (e.g.: rewards) • emphasis on convergent thinking • emphasis on lower-level thinking skills (memorizing, recalling information) • individualized learning and achievement • little or no choice regarding attendance, involvement, time on task, movement • abstract lessons • individual cognition and performance • pure mentation (abstract thinking, such as long division algorithms) • symbolic thinking and unilateral transfer of decontextualized knowledge • focus on learning general skills and knowledge • presented problems and predetermined solutions or right answers • content prescribed and tightly regulated • content organized and sequenced • attention focused on lesson by teacher • all students experience all content • large homogeneous groups of children (with respect to age and abilities) chosen by teacher • takes place in formal, teacher-centered classrooms where students are assigned specific desks 	<ul style="list-style-type: none"> • learner-centered activity • learners establish own goals • mostly a noncompetitive environment • nonevaluative, or self-evaluative • cooperation and collaboration valued • many contextually relevant learning opportunities • intrinsic motivation (e.g.: curiosity) • opportunities for divergent thinking • opportunities for using higher-level thinking skills (questioning, evaluating) • social setting encourages group learning • free choice setting regarding time, involvement, attendance, movement • often concrete, "hands-on" experiences • shared cognition and team work valued • tool manipulation (using cognitive tools such as a book of tide tables) • opportunities for contextualized reasoning and teaching others • focus on acquiring situation-specific competencies • discovered problems and alternative solutions • content variable, changing, unique • content often not organized or sequenced • attention self-directed • learner chooses content of interest • small heterogeneous groups of children of learner's choice, or child is solitary by choice • takes place in museums, zoos, science centers, homes, clubs, recreational sites; may also take place in learner-centered classrooms

Falk, Koran, and Dierking (1986) argue that these conditions facilitate the learner's ability to relate content to prior knowledge and personal experiences, thus leading to increased probability that self-directed learning and generalization beyond specific content will occur.

However, even though science centers and museums promote free choice with respect to attention and involvement, the exhibits often have predetermined learning objectives/outcomes that preclude children establishing their own goals. Science museums may have learning opportunities that are relevant to the interests of individual visitors, but for Falk, Koran, and Dierking to assert that these opportunities are "contextually relevant" is to make a broad unwarranted generalization. "Contextually relevant" is descriptive of the learning opportunities espoused by situated cognition theorists who advocate learning through apprenticeship in cultural practices.

In addition, conclusive research is needed to support Falk, Koran, and Dierking's assertion that heterogeneous groupings of children promote more effective learning than a homogeneous grouping of peers of the child's choice. Furthermore, competition is a social phenomenon. To assert that social environments such as science museums are noncompetitive and nonevaluative is to make another unwarranted assumption. Instead, these researchers could have sought evidence to support their claim that these environments promote nonevaluative and noncompetitive activities amongst the visitors, and if so, whether there is any evidence to support their claim that nonevaluative and noncompetitive experiences encourage group learning.

Some researchers have made similar conclusions regarding Falk, Koran, and Dierking's criteria for effective learning environments. Busque's (1991) research on the characteristics of museums which enhance visitors' interest in exhibits supports their findings. Busque noted that museums promoted heterogeneous, voluntary participation in open activities where visitors could set their own goals. McManus (1992) investigated the physical settings of science museums with the intent of determining the conditions which would support learning if the visitors were motivated. She found that the social

context of museums affected the learning-related behaviour of visitors, particularly the shared investigation and exploration of ideas. Carlisle (1985) judged the science center as an effective learning environment as

It provides a context that motivated, encouraged meaningful behaviour and social interaction, was pleasurable, and held the potential for learning scientific facts and principles (p. 32).

Diamond's (1986) research on visitor behaviour in science centers noted that these facilities attempt to create

a playful, unstructured environment in which people can explore and investigate objects and natural phenomena and to which they can bring their own learning styles and experiences (p. 140).

Carlisle and Diamond both discuss what science centers provide and promote rather than make grand statements about learning outcomes as was previously noted.

Price and Hein's (1991) research findings on science learning in non-school settings such as museums add to the list of features of informal environments that are conducive to learning. (See Table 1.) These researchers define educationally effective museum programs as those in which

products are not emphasized, inquiry is sparked, open-ended questions are generated, and students actively participate and appear involved....We believe that good teaching encourages divergent thinking (p. 510).

Price and Hein argue that "informal science experiences lead to important affective changes which are less frequently measured and often overlooked" (p. 511). These researchers also noted the following features of informal settings that are conducive to learning:

- The size of the group can affect learning. Students working in small groups were more able to ask questions and receive answers, did more hands-on work, and became more involved in their learning (p. 511).
- Museums concentrate on higher learning skills such as observation, questioning, and exploration (rather than facts) (p. 514).
- Interactive learning experiences are much more effective than lectures or demonstrations....Students' questions are important indicators of interest as well as knowledge and ignorance (p. 514).
- Educationally successful programmes provide students with opportunities for first-hand experience and observation....Vocabulary and concepts should follow experience and observation. This order encourages divergent thinking, questioning, and the development of observational skills (p. 515).

However, these features of educationally effective museum programs that Price and Hein (1991) believe are conducive to learning are also features of teacher-centered learning, rather than learner-centered experiences, as the list does not suggest there is any opportunity for free choice on the part of the students. Thus, Price and Hein's view incorporates some of the characteristics of formal and informal approaches to learning.

(2) What are the features of effective exhibits?

In Feher's (1990) study of interactive museum exhibits as tools for learning, she outlined some important characteristics of successful exhibits:

- The exhibit must attract and hold the visitor's attention...and have the ability to surprise the user.
- The interactive aspect of the exhibit is achieved by incorporating elements that afford the visitor the possibility of asking and answering "What if?" questions.
- The exhibit offers the visitor an opportunity to go "messing about" with playful exploration.
- The conceptual content of the exhibit needs to be matched to the prior knowledge of the learner (p. 36).

In contrast to Price and Hein's list of features that are more descriptive of teacher-centered learning in informal settings, Feher's list indicates that effective exhibits promote learner-centered activity.

Attracting and holding visitors' attention is a recurring theme in research findings on what makes an exhibit effective. Falk (1991) analyzed the behaviour of museum visitors, and he observed that paying attention to an exhibit was the predominant behaviour. Falk theorized that attention is the first step in any learning sequence, and this view extends Csiksentimahalyi's (1987) belief that intrinsic motivation is needed to focus attention initially. Then, Csiksentimahalyi argues, intriguing aspects of an exhibit, social interaction, and encounters with discovered problems help to keep visitors' attention focused. In Falk, Koran, and Dierking's (1986) assessment of the learning potential of science museums, they asserted that visitors arrived at museums predisposed to learning

science and motivated by a personal curiosity or interest in the topic. These researchers generalized that

- Most visitors arrive at the museum with an appropriate “learning set”—they perceive these institutions as possessing interesting, stimulating, and important ideas/things that are worth seeing/learning about.
- Once their attention has been “grabbed,” visitors will spend varying amounts of time looking/interacting with the exhibit depending on interests, experiences, and expectations.
- It is likely that cognitive learning will occur at any exhibit at which a visitor spends a “significant” amount of time engaged in appropriate behaviour for the exhibit (p. 506).

Falk, Koran, and Dierking (1986) add that this generalization is “only mostly true, most of the time” (p. 506), but they state that

It is safe to conclude...that people do look at exhibits and do learn something. What people learn from exhibits, and how, is less clear (p. 504).

Beer’s (1987) study of museum visitor behaviour found that manipulables seem to be a catalyst in getting visitors to interact, but she also observed that the exhibits alone do not hold visitors’ attention for long. Busque (1991) observed that the attention of visitors is initially attracted and then held by the interactive and investigative potential of exhibits. Busque concluded that effective exhibits have three characteristics (and functions): attracting power (the ability to stop visitors), holding power (the ability to cause visitors to remain with the exhibit), and teaching power (the ability of an exhibit to convey its intended message).

Busque’s notion of the attracting, holding, and teaching power of exhibits is an underlying theme of McManus’s (1989) research on visitor behaviour in museums. McManus found heightened levels of verbal activity at interactive exhibits and she concluded that effective interactive exhibits encourage social interaction. She observed that museum visitors are highly motivated to attend to exhibit communications within a social, recreational context. McManus also noted that museums can be a presentation of ecological systems, and she concluded that exhibits likely to arouse a personal response, especially ideas related to ecology, were important in motivating visitors to attend to the exhibits and in affecting their learning-related behaviour.

Exhibits conducive to effective learning offer more to users than just physical manipulations or "hands-on science." Lucas (1983) argues, "It is false to assume that any physical manipulation of an exhibit provokes intellectual engagement" (p. 9). Lucas also believes that the design of effective interactive exhibits is based on the assumption that

When visitors can control the exhibit in some way, where interactions provoke "puzzlement," and/or where "thinking" is required to produce an appropriate response, then learning will occur (p. 10).

Like Lucas, Tuckey (1992) also believes that interaction means more than just touching exhibits and that effective exhibits promote thinking. Tuckey's research findings on children's informal learning at a science center extends Feher's (1990) emphasis on the importance of matching the exhibit's conceptual content to the user's prior knowledge by arguing that "an effective exhibit will provide an experience which interacts with pupils' current concepts and hence create new understanding" (p. 277). Flexer and Borun's (1984) findings indicated that the particular strength of participatory exhibits is their effectiveness in conveying science principles rather than teaching vocabulary.

In Csikszentimahalyi's (1987) study of visitors' behaviour in a science center, he distinguished between "presented" problems and "discovered" problems:

With a presented problem, someone knows in advance what must be done, the rules for doing it are also known, there is an accepted method of solution, and an agreed-upon-answer....Solving presented problems is rarely enjoyable or intrinsically rewarding. People get involved more and learn more from discovered problems...that involve bits and pieces of tantalizing information, but where you have to figure out for yourself what needs to be solved, what the problem is, and how to go about the solution (p. 85).

Csikszentimahalyi believes there should be more emphasis on having children discover what the problem is, find out what the challenges are, and select their own goals so that they will become "hooked" on the problem. He argues that "if there are alternative solutions possible, then it is even more likely that there will be involvement" (p. 86). He suggests that the characteristics of an experience such as discovered problems make an interactive exhibit intrinsically motivating and hence conducive to learning in an informal setting. I believe that this is an important characteristic to consider in the classroom setting

when designing hands-on science activities.

(3) How does the social context of exhibits influence visitors' behaviour and learning?

Several researchers (Carlisle, 1985; Diamond, 1986; Feher, 1990; Stevenson, 1992; McManus, 1992) have observed children's verbal and non-verbal behaviour in the social context of science centers and museums. Their findings provide insights on how children share their experiences in an informal social context. These insights have implications for educational practice as well as for the interpretation of the present study.

Social interaction is a central theme in research studies conducted in science centers and museums. Carlisle (1985) observed that children's initial interaction with science center exhibits was predominantly a solitary experience and that children's behaviour at exhibits was individualistic. He concluded that a visit to a science center is

both a solitary and a social experience. Many of the children observed the exhibits as individuals and then shared their experience. Some children took the role as explainers, introducing other children to an exhibit (p. 32).

Like Carlisle, Diamond (1986) also believes that a museum is a setting where children can learn about science "and then share their experiences with family, friends, and even strangers" (p. 139). Diamond's research supports Carlisle's findings as she also observed that children were likely to manipulate exhibits by themselves while parents watched or read labels to them.

Several researchers have studied family learning strategies in museums (Diamond, 1986; Hilke & Balling, 1989; Feher, 1990; McManus, 1992; Stevenson, 1992). Diamond's research investigated how social factors, especially teaching behaviours, operate in the informal setting of a science museum. She argued that teaching influences the attitudes of people as they interact with phenomena. In her research, Diamond focused on the social interactions of family groups and how family members influence each other's behaviour. Her research methods involved recording observations of behaviour in the

form of running narratives and then transforming this data to generate a scheme of behavioural categories. The family teaching behaviours in these categories included: showing, pointing, giving someone something to look at, telling another member to do something, pulling someone across to an exhibit, describing something, and raising questions. Diamond (1986) concluded that

Teaching occurs as a fundamental aspect of the spontaneous social interactions of family members in science museums....Social interaction in the museum occurs as a reciprocal activity, and all parties appear to benefit from it....Family members communicate in different ways and also experience objects in the environment differently....This mutual exchange of information is an important aspect of the learning process in the science museum (p. 153).

Diamond's findings are echoed in Hilke and Balling's (1989) research on family learning strategies in museums, especially the observation of spontaneity in social interactions. These researchers observed that the information each person was exposed to in hands-on science exhibitions was heavily influenced by the broadcasting of commentaries by other family members. They reported that shared information was mostly concerned with facts and to a lesser degree with accounts of personal interpretations and experiences. Hilke and Balling concluded that information exchange occurred as the spontaneous unsolicited sharing of aspects of the commentator's experience. More recently, Stevenson's (1992) study on family groups in interactive centers observed that the children spent most of their time in social interaction and information exchange with others rather than spending a lot of time rushing about the exhibition. Bateson (1994) stresses the importance of informal social settings in fostering collaborative learning:

The most fruitful innovation in education may prove to be a new emphasis on collaborative learning at every level....Science is not only a method of discovery and verification, it is a pattern of sharing knowledge (p. 73).

Lucas and McManus (1986) inferred that learning also takes place vicariously as children watch others interacting with exhibits. Beer (1987) similarly observed visitors learning to operate manipulables by watching others use them, not by reading the directions. Vicarious learning was also a common behaviour observed in Diamond's (1986) study of family teaching behaviours in science museums. She found that visitors'

attitudes as well as behaviour were influenced by observing other family members manipulating exhibits and listening to them talking about the exhibits.

The social context of informal learning environments such as science centers and museums influences not only visitors' verbal and non-verbal behaviour, but also their perceptual and conceptual development. Feher (1990) believes that "people are explanatory creatures. They form theories or mental models to explain what they experience" (p. 36). She describes the science learning process as an experiential, exploratory, and explanatory process, where the children first undergo an experience in which they can actively participate, and then they give meaning to the experience through their own interpretations and explanations. Her research with interactive museum exhibits examined the intuitive notions that children bring to novel situations and how these shape their interpretations of the phenomena which the children observe and manipulate. Feher's findings indicate that children do not necessarily confront their own misconceptions when learning from exhibits, and they may instead construct models which build on these misconceptions. She confirms that

Users learn subject matter and process. If we examine the exhibit as a teaching device, we can distinguish four levels of engagement with exhibit phenomena:

- (1) Experiencing: The exhibit shows that certain phenomena occur in nature.
- (2) Exploring: Users discover new features of the phenomena by manipulating the exhibit.
- (3) Explaining: Users are explanatory beings who form mental models or theories to explain what they experience.
- (4) Expanding: Users generalize ideas through active involvement with other related exhibits (p. 46).

Feher's research on the levels of engagement in learning extends Carlisle's (1985) study which was designed "to gain insight into what children look at, how long they look, and the level at which they interact with each exhibit" (p. 27). Feher's research finding that users' experiences and explorations precede their explanations supports Carlisle's observation that children tend first to explore by themselves and then to share with others, often in the role as explainers.

Grumet (1992) asserts that insights, such as these findings about effective exhibits and environments for learning, cannot prescribe teachers' actions in the classroom but they can inform them. Insights from the research findings on learning in informal environments such as science centers and museums informed my research by providing analogies to the fishing experiences and interactions in the "Catch of the Day" case study. Diamond's (1986) categories of family teaching behaviours and Feher's (1990) categories of levels of engagement in learning provided me with relevant schemes to categorize and analyze the data of my field study in order to gain an understanding of the fishing event's complexities and to reveal subtle meanings salient to the participants.

Constructivist Perspectives On Learning

Paradigms and perceptions

When you get a new model, a new paradigm, a new way of perceiving, new definitions of the old words, words which now mean something else, suddenly, you have an illumination, an insight....You can see things in a different light....Wisdom is the way in which knowledge is held. It concerns the handling of knowledge, its selection for the determination of relevant issues, its employment to add value to our immediate experiences.

A. N. Whitehead (1949, p. 41)

Kuhn (1962) argues that "something like a paradigm is prerequisite to perception itself" (p. 113). "When you get a new paradigm, a new way of perceiving," states Whitehead, "you can see things in a different light" (p. 41). For some educators, the constructivist paradigm is an alternate way of perceiving, one that offers them a different perspective to look at how knowledge is held, handled, selected, and employed. From a constructivist perspective, children's perceptions are illuminating for they provide insights into children's learning, motivations, intentions, and understanding of phenomena as they experience it.

Basic assumptions of constructivism

The question, "How is meaning constructed?" permeates the constructivist perspective on learning, a position that emphasizes the active agency of the learner and asserts that each learner builds or constructs his or her own reality. The roots of the constructivist perspective, that knowledge is a human construction, can be found in Dewey's (1902) writings:

Subject matter never can be got into the child from without. Learning is active. It involves reaching out of the mind....It involves organic assimilation starting from within (p. 6).

Dewey's educational theories (1902, 1916, 1938, 1958) stressed the development of intelligence through collaborative problem solving and reflective inquiry as children interact with their environment in a social context. The current trend towards hands-on inquiry in science classrooms reflects Dewey's (1902) belief that

The child is inherently an active being with impulses to communicate with others, to construct things, to investigate, and to create....Opportunities should be given to the child to develop these impulses by engaging in activities (p. 6).

However, for constructivists, a hands-on curriculum is not enough.

Constructivists see the essential activity as what goes on in the child's head, not in his/her hands. Whitehead (1925) argued that we construct thought; we do not discover it. He insisted that the mind is not a blank tablet to be imprinted but rather an organizer of thoughts which lie inside not outside of experience. Piaget (1971) echoed Dewey's and Whitehead's constructivist perspectives with his own succinct assertion: "Knowledge is constructed, not copied" (p. 28).

Dewey (1938) also conceived of experience at two levels: a concrete, practical, active level (hands-on experience); and an abstract, reflective, refined level (an intellectual revisiting):

The distinction is one between what is experienced as the result of physical activity or doing, and what is experienced in consequence of reflective inquiry on those doings (p. 5).

Thus, the intellectual revisiting is an abstract reflection on what has already occurred concretely in order to connect that active “doing” with other experiences and to speculate on other possibilities and alternative actions.

Within the constructivist perspective learners are viewed as building mental representations of the physical and social world around them. These mental representations or conceptual schemes are used to interpret new situations and experiences and to guide action in them, and they are continually revised to become more consonant with experience.

Driver (1989) sees learning as an adaptive process,

one in which the learners’ conceptual schemes are progressively reconstructed so that they are in keeping with a continually wider range of experiences and ideas. It is also seen as an active process of ‘sense making’ over which the learner has some control. In as far as it views learners as architects of their own learning through a process of equilibration between knowledge schemes and new experiences, this perspective builds on Piagetian research (p. 481).

Like Dewey (1938), who expressed a constructivist view by asserting that there can be no intellectual growth without some reconstruction, Driver argues that from a constructivist perspective learning is viewed not simply as the accretion of new ideas, but as a reconstruction of meaning. This premise has significant implications for teaching and learning.

Holistic approach to learning and the construction of meaning

Csikszentimihalyi (1987) studied human behaviour in science museums, and he views learning as holistic, involving the whole person: “It involves the senses, the desires, the longings, the feelings, and the motivations as well” (p. 81). Csikszentimihalyi believes that museum visitors should experience exhibits at the sensory level, at the emotional level, as well as at the cognitive level. In his opinion,

We tend to have an over-rationalized, over-intellectualized view of the learning process. Laypersons as well as psychologists believe that the only important thing about learning is the manipulation of information in the learner’s mind. They believe that this cognitive, conceptual process is the important issue about learning. But learning involves the whole person, not just the rational mind (p. 81).

One of the problems Csikszentimihalyi (1987) sees with using the computer as a model for human learning is the difficulty in motivating people to want to learn. He believes that museum educators need to have a better understanding of how people learn in order to motivate visitors. He states that

Theories of how people learn generally emphasize one of two approaches. The first sees the main task as transmitting and assimilating data, or passing on as much information as possible to the learner. The second stresses the importance of strategies for making sense out of the data, of learning scientific principles and laws. These two are often presented as opposite approaches.... They are not.... They are complementary processes (p. 81).

Unfortunately, Csikszentimihalyi is confusing "teaching" and "learning" in this brief assertion, as "transmitting" and "passing on data" are teaching methods assumed to be effective in a transmissive approach to education. "Assimilating data," on the other hand, is a process that occurs in the learner's mind, not a teaching practice. Piaget's notion of "assimilation" is really present in both approaches, transmissive and constructivist, as making sense of the data involves assimilating the information into the learner's existing mental models to construct new knowledge. The point that Csikszentimihalyi is trying to make is that the transmission, assimilation, and storage approach as well as constructivist approach of sense-making "are complementary processes.... Both are important and should be represented in the ideal learning environment" (p. 81).

Like Csikszentimihalyi, Gunstone (1987) also stresses a holistic view of learning that involves a learner's purposes and motivations. Gunstone lists six issues emphasizing the second approach, a constructivist view of the process of learning:

- Learning outcomes depend not only on the learning environment, but also on the knowledge, purposes, and motivations the learner brings to the task. The ideas and beliefs we already hold will be of major influence on the interpretation we place on what we are taught.
- The process of learning involves the construction of meanings and these may not be the meanings intended by the teacher, thus understanding cannot be directly transmitted from teacher to learner.
- The construction of meaning is a continuous and active process.
- Having constructed meanings, learners will evaluate them and consequently accept or reject them.

- Learners have the final responsibility for their learning; learners make their own sense of their experience.
- There are commonalities in the meanings students construct (p. 78).

Csikszentimihalyi's (1987) view that museums provide opportunities for visitors to interact with exhibits at different levels is similar to Feher's (1990) view that visitors' interactions with exhibits involve different levels of engagement in learning. Both acknowledge the importance of sensory and perceptual experiences in engaging visitors in learning (Feher's levels of Experience and Explore). Csikszentimihalyi's cognitive level is echoed in Feher's Explain and Expand levels.

Csikszentimihalyi points out that "the basic fact about any form of learning is that the learner must get involved" (p. 82). He believes that people will get involved with discovered problems for intrinsic reasons, particularly experiences that match challenges and skills. He urges educators to consider ways for people to interact with exhibits by engaging in experimentation and manipulation that leads them to the discovery of scientific principles and properties on their own.

The constructivist perspective, exemplified in the work of a wide range of educators and philosophers (Dewey, 1938; Driver & Erickson, 1983; Driver, 1987; Gunstone, 1987; Tobin, 1993), advocates identifying the ideas students hold prior to the study of a particular topic, but in the context of personal, social, and cultural influences that impact the learning setting. Shapiro (1994) is a constructivist who also has a holistic view of learning. She used a case study approach to investigate children's learning with light phenomena. Like Csikszentimihalyi (1987), Shapiro advocates beginning with the personal experience of the learner and she takes the position that "we must understand learning not only as a cognitive experience but also as an emotional, personal, social, and cultural one" (p. xiv). Her intention was to look in fresh ways at what goes on in classrooms. Her research approach in working with the children in developing and organizing the case reports places emphasis on listening. She believes her study is an exploration of what may result when we learn to listen differently to one another:

Conversation has been the main form of data gathering in the study. An attitude of "sensitive listening" was the essence of the research attitude and my approach to working with the children has been one of friendship and caring. Because reflection was accomplished with the children, the nature and quality of our relationship was crucial to the success of the study. Every child attempts to make sense of the world, each in a unique and personal manner. We need to listen to these approaches with a view of teaching that values these unique approaches (p. xx).

Problem solving in informal environments and the construction of models

Problem solving is an essential part of the process of science in schools, but it is also a central feature of learning in informal settings. Csikszentimihalyi (1987) has pointed out the educational value of discovered problems in informal settings where problems emerge from naturally occurring dilemmas. He believes that contextualized reasoning is promoted whenever children have opportunities to resolve their own discovered problems, "where you have to figure out for yourself what needs to be solved, what the problem is, and how to go about the solution" (p. 85). Csikszentimihalyi also believes that it is intrinsically rewarding for children to discover their own problems as they arise and to design alternative solutions to resolving these. Since children use a broad range of high-order problem-solving skills when faced with open-ended problem situations, these findings have important implications for practice in schools.

Figuring out "the problem" is also a theme found in the research of Meyer (1991), who investigated children as experimenters. Meyer's viewpoint is that "in any investigation, the knowledge held by the investigator (student) influences the hypotheses generated, types of experiments conducted, and the interpretation of results" (p. 22). She examined learners' intentions and knowledge while experimenting with magnets with a partner, and she concluded that student action was goal-directed and purposeful. In her explanation of Action Theory, she argues that

In the action context, people cannot attend to all the information from the surrounding environment and must select features from the setting relevant to the purpose or problem at hand....The framing of a situation in light of a problem distinguishes possible action strategies we can implement and how to interpret the consequences of our actions (p. 38).

Meyer's (1991) study builds on Feher's (1990) belief that people are explanatory creatures forming theories or mental models to explain what they experience. Her research also supports the generative learning model proposed by Osborne and Wittrock (1983) who argue that

To comprehend what we are taught verbally, or what we read, or what we find out by watching a demonstration or doing an experiment, we must invent a model or explanation for it that organizes the information selected from the experience in a way that makes sense to us, that fits our logic or real world experiences, or both (p. 493).

Using observations, videotapes of students' actions, and informal interviews, Meyer gathered data that demonstrated students' construction of models to understand how magnets interact with different objects. Feher's (1990) levels of engagement in learning are applicable to Meyer's study as the students experienced what the magnets could do, they explored a variety of magnet and object combinations, and they explained the mental models that they constructed. Meyer's data collection methods were appropriate for identifying these levels of engagement and congruent with the kind of qualitative data that I gathered in the present study.

Bateson (1994) also shares a constructivist philosophy of problem solving in an informal setting: "We all arrive as strangers at the moments of crisis in our lives, having to improvise responses from previous learning" (p. 27). Her view of problem solving is reflected in her approach to ethnography: "It is a way of being...learning along the way" (p. 7). Improvising responses is also involved in Resnick's (1987) view of problem-solving:

Self-conscious meaning construction and interpretation skills are likely to be needed...when one must use powers of reflection and analysis to craft sensible responses to new situations (p. 18).

The constructivist view of learning provides a framework for interpreting children's explorations of science concepts and problem-solving strategies at interactive science centers and museums. Tuckey's (1992) research findings in these settings support those in Feher's (1990) study in which children were observed interacting at four levels of

engagement with exhibits (experience, explore, explain, expand). Tuckey noticed that

The children seemed to combine experiential knowledge gained from interaction with exhibits and their everyday knowledge in order to create new understandings. Prior knowledge was shown to be important in enabling pupils to construct plausible hypotheses about exhibits (p. 273).

Tuckey observed that children engaged in problem solving by drawing analogies with familiar everyday situations. Driver (1989), a constructivist, states that learning is

an adaptive process of conceptual change in which the learner's conceptual schemes are progressively reconstructed so that they are in keeping with a continually wider range of experiences and ideas (p. 482).

Driver also sees learning as an active process of "sense making" over which the learner has some control.

Constructivist paradigm and research design

Piaget, a scholarly giant in the field of cognitive development and constructivism, saw learning as a series of qualitative changes in what one knows, how one comes to know, and how one uses knowledge (Furth, 1970). Feher and Rice (1985) studied the development of scientific concepts through the use of interactive exhibits in a science museum. Like Piaget, these researchers were interested in investigating how learning occurs and how it can be enhanced. They were specifically interested in studying the intuitive notions that learners bring to a situation and how these aid or hinder the acquisition of certain scientific concepts. Using Piagetian-style questioning techniques (e.g.: What do you see? How can you explain this?), they sought to uncover children's thought processes by having the children verbalize as they investigated phenomena in museum exhibits.

In Tuckey's (1992) study, children were asked to explain what they were doing and what was happening in order to encourage them to build explanatory models of the exhibits. Tuckey points out that "the corollary of the constructivist view is that multiple explanations may be possible" (p. 274). Such verbalizing gave the researchers an insight into whether children were assimilating or accommodating scientific concepts and principles (Furth, 1970), and whether children were in the "Gee-whiz!" phase of

experiencing or moving into the “Aha!” moments of insight and understanding.

Baron (1993) believes that understanding key concepts in marine education through experiential learning is fundamental to understanding ecological interdependencies. In her study on Seaschool, Baron found that the most important connections that participants made to environmental issues were the ones they made themselves. Baron claims that the greatest value of Seaschool is the authentic experience itself, and thus she makes a strong argument for the educational value of such an endeavour. This perspective guided the evolution of the Seaschool program from a teacher-centered to a more relevant learner-centered program.

The nature of the value claims that Baron makes in her study rests on the solid theoretical framework and assumptions about learning (that learning is a continuous interactive process) that drives her vision of change. Baron developed a system of using different mechanisms for feed-back and evaluation, such as observations, questionnaires, interviews, and videotape transcriptions, because she believes it is important for researchers not to make assumptions about learners' experiences and their personal interpretation of what is relevant. Her world view, or paradigm, is constructivist in philosophy for she asserts that individuals “translate” their experiences in light of their previous beliefs, experience, and knowledge, and that these experiences are translated differently by different individuals. She found that using a variety of forms of feed-back mechanisms resulted in a deeper exploration of participants' views and understandings, and these findings are very relevant to the present study as feed-back mechanisms to establish validity or trustworthiness.

Lucas and McManus (1986) believe that museums provide a useful setting to investigate the *process* of learning from informal sources, not just the *product*. They point out that

So far, there has been little research that focuses on *how* people learn both in and from informal settings. Knowing *how* people learn might be more important than knowing *what* they learn (p. 343).

Lucas and McManus (1986) believe that talk can reveal a great deal about the thought processes of participants in a conversation and that important inferences can be made about visitors' verbal as well as non-verbal behaviour in informal settings. These researchers used audio and video recorders as unobtrusively as possible in their investigations in order to listen to and record visitors' conversations in science museums. They were aware of the risk of behaviour changes in the observed visitors, which they described as "playing to the gallery" (p. 345), and they advised that this occurrence needs to be taken into account in any interpretation of the data.

Lucas and McManus emphasized the importance of previous experience and the context of the exhibit. They also suggest that "We need to be alert to unintended exploratory behaviour which may be as 'scientific' as the planned possibilities" (p. 351). Bateson (1994) believes that participant observation is more than a research method. It involves an intuitive alertness to the kind of unintended exploratory behaviour valued by Lucas and McManus. Bateson describes her notion of "peripheral visions" by suggesting that "essential themes are not clearly marked but rather visible only out of the corner of the eye," (p. 8).

Situated Cognition

Conditions of learning and implications for educators

Csiksentimahalyi (1987) asks, "What are the conditions of learning in informal settings that one should be aware of?" (p. 81). Resnick (1987) points out that the physical setting is only one component of effective learning. She compared learning in school and out and identified four general classes of discontinuity between learning in school and the situated nature of cognitive activity outside school. (See Table 1 for a list of the contrasting features of "formal" and "informal approaches to learning.") Resnick (1987) points out that the characteristics of mental activity outside school stand in contrast to typical school work:

- Schooling focuses on the individual's performance, whereas out-of-school mental work is often socially shared (individual cognition in school versus shared cognition outside).
- Schooling aims to foster unaided thought, whereas mental work outside school usually involves cognitive tools (pure mentation in school versus tool manipulation outside).
- School cultivates symbolic thinking, whereas mental activity outside school engages directly with objects and situations (symbol manipulation in school versus contextualized reasoning outside school).
- Schooling aims to teach general skills and knowledge, whereas situation-specific competencies dominate outside (generalized learning in school versus situation-specific competencies outside) (p. 16).

Resnick uses these characteristics and the terms "typical school work" and "schooling" to describe the extreme traditional approach to learning as summarized in Table 1.

However, individual teachers in schools may or may not focus on these aims. Since teachers exhibit a wide range of teaching practices selected from both "formal" and "informal" approaches to learning, Resnick should have explained that she was accentuating the discontinuity and making general statements to emphasize the need for more attention to be given to out-of-school functioning such as apprenticeship.

Resnick (1987) examined programs claiming to teach thinking skills, learning skills, or higher order cognitive abilities. Her intent was to look for elements common to successful programs that could point to a theory of how learning and thinking skills are acquired. She found three key features:

- Most of the effective programs have features characteristic of out-of-school cognitive performances. They involve socially shared intellectual work, and they are organized around joint accomplishment of tasks so that elements of the skill take on meaning in the context of the whole.
- Many of the programs have elements of apprenticeship. That is, they make usually hidden processes overt, and they encourage student observation and commentary. They also allow skill to build up bit by bit, yet permit participation even for the relatively unskilled, often as a result of the social sharing of tasks.
- The most successful programs are organized around particular bodies of knowledge and interpretation—subject matters—rather than general abilities. The treatment of the subject matter is tailored to engage students in processes of meaning construction and interpretation that can block the symbol-detached-from-referent thinking that I have noticed is a major problem in school (p. 18).

Resnick's (1987) findings on the features of successful programs suggest implications for education:

When we begin to focus attention on thinking and learning abilities as goals of education, the distinctions between learning in school and out seem less sharp (p. 19).

Other researchers are in agreement. Lucas's (1983) article on scientific literacy and informal learning discusses a framework for thinking about questions of informal learning and its interaction with school science learning. Lucas argues that

School courses could be judged on how well they provide a framework for future informal learning. We need to have some idea of the ways people learn from other sources....Even for those of us whose main activity is teaching science in formal settings, it could be quite important to understand how learning in the informal sector interacts with formal teaching. Most learning from informal sources takes place if the material is placed in context, or where the information is of 'value' to the learner (p. 28).

Resnick (1987) advocates change in educational practices and aims as she summarizes her article on learning in school and out:

Schools should focus their efforts on preparing people to be good adaptive learners so that they can perform effectively when situations are unpredictable and tasks demand change....Evidence is beginning to accumulate that the traditional school's focus on individual, isolated activity, on symbols correctly manipulated but divorced from experience, and on decontextualized skills, may be partly responsible for the school's difficulty in promoting its own in-school learning goals (p. 18).

To effect change, Resnick urges educators to redirect the focus of schooling to encompass more of the features of successful out-of-school functioning such as socially shared intellectual work organized around the joint accomplishment of tasks, elements of apprenticeship that allow skill to build up bit by bit, and programs organized around bodies of knowledge rather than general abilities.

Legitimate peripheral participation

The literature review suggests there is a connection between effective learning and the social environment and between free choice contexts and engagement in learning. Researchers have described criteria for effective learning that moves away from teacher-centered programs to a more learner-centered environment. However, Lave and Wenger's (1991) conception of situated cognition takes Dewey's (1938) "learning by doing"

philosophy, experiential learning programs, and the “hands-on” emphasis of interactive exhibits at science centers a step further into the dimension of authentic experience.

Lave and Wenger (1991) urge educators to undertake a radical and important rethinking and reformulation of our conception of learning, which also applies to the context of the present study. Like Csikszentimihalyi (1987) and Shapiro (1994), Lave and Wenger view learning holistically:

By placing emphasis on the whole person and by viewing agent, activity, and world as mutually constitutive, they give us the opportunity to escape from the tyranny of the assumption that learning is the reception of factual knowledge or information....Most accounts of learning have ignored its quintessentially social character. We make the crucial step away from a solely epistemological account of the person, and propose that learning is a process of participation in communities of practice, participation that is at first legitimately peripheral but that increases gradually in engagement and complexity (p. 3)....The situated nature of learning, remembering, and understanding is a central fact (p. 11).

Lave and Wenger focus on the relationship between learning and social situations in which it occurs and situate learning in certain forms of social coparticipation. Like Bateson's (1994) notion of participation as “a way of being...learning along the way” (p. 7), Lave and Wenger also believe that learning is a way of being in the social world, not just a way of coming to know about it. They view learners as engaged both in the contexts of their learning and in the broader social world within which these contexts are produced. Echoing Dewey's philosophy (1938), Lave and Wenger assert, “Without this engagement, there is no learning, and where the proper engagement is sustained, learning will occur” (p. 24).

Lave and Wenger argue that “a learning curriculum unfolds in opportunities for engagement in practice” (p. 93). These researchers want to rescue the idea of apprenticeship, a synonym for situated learning, which they believe is more encompassing than Dewey's (1938) notion of “learning by doing.” Their notion of legitimate peripheral participation has the same characteristics that Resnick (1987) noted in successful learning programs: “joint accomplishment of tasks....elements of apprenticeship allowing skill to build up bit by bit” (p. 18). Rather than asking what kinds of cognitive processes and conceptual structures are involved, Lave and Wenger (1991) ask, “What kinds of social

engagements provide the proper context for learning to take place?" (p. 14). Lave and Wenger argue that this shift alters the locus of learning:

Learning is a process that takes place in a participating framework, not in an individual mind. This means that it is mediated by the differences of perspective among the coparticipants....Thus, learning is distributed among coparticipants, not a one-person act" (p. 15).

Lave and Wenger believe that a person's intentions to learn are engaged and the meaning of learning is "configured through the process of becoming a full participant in the sociocultural practice" (p. 29). Driver, Asoko, Leach, Mortimer, and Scott (1994) define the social construction of knowledge as a blend of constructivist and situated cognition perspectives:

From this perspective knowledge and understandings are constructed when individuals engage socially in talk and activity about shared problems or tasks. Making meaning is thus a dialogic process involving persons-in-conversation, and learning is seen as the process by which individuals are introduced to a culture by more skilled members (p. 7).

Storying: The Construction Of Meaning In Authentic Contexts

Wells (1986) describes children as meaning-makers. In his study of children's experience with language in naturally-occurring social contexts, he observed the active role that children play in their own learning as they construct both an internal model of the world and a linguistic system for communicating about it. From a constructivist perspective, Wells argues that "in every act of perception, the world 'out there' is interpreted in relation to the inner mental model in terms of which that world is represented" (p. 196). Thus, he believes that making sense of experience is to a very great extent being able to construct a plausible story about it.

Constructing plausible stories is a central tenet in Driver's (1983) constructivist view of the pupil as scientist. She points out that

The role of the imagination in learning science is rarely emphasized, yet it probably plays a very significant part in enabling pupils to grasp new ideas.... They have to construct the ideas in their imagination (p. 45).

Driver and Erickson (1983) extend the student-as-scientist metaphor to suggest that in constructing their own knowledge, learners also gain some appreciation of science as “the pursuit of the human imagination” (p. 55). Bateson (1994) also believes that imagination has an important role in learning:

The best learners are children, not children segregated in schools, but children at play, zestfully busy exploring their own homes, families, neighbourhoods, and languages, conjuring up possible and impossible worlds of imagination (p. 73).

Wells (1986) believes that children’s stories are not only expressions of their attempts to find meaning in their experiences but also a means of entering a shared world with others and exchanging stories. He noticed that whenever people get together in social groups they begin to exchange stories in the form of personal narratives, anecdotes, or just snippets of gossip. Wells refers to the oral tradition of many cultures to suggest that

Although storying may have its roots in the biologically given human predisposition to construct mental stories in order to make sense of perceptual information, it very quickly becomes the means whereby we enter into a shared world, which is continually broadened and enriched by the exchange of stories with others (p. 195).

Wells shares the constructivist view on multiple perspectives which claims that for any experience or set of events there is almost always more than one possible interpretation. Consequently, since Wells believes that “the evidence is never so unambiguous as to rule out alternative interpretations” (p. xii), he argues that there can be no true stories.

Wells also explains that multiple realities are jointly constructed in a shared collaborative setting. In the oral tradition of story-telling, stories are created in the telling and are influenced by the impromptu exchange of other stories shared in the social group. Thus, Wells argues that stories offer more than a personal interpretation of sensory and perceptual experience. He maintains that because stories occur in the context of social interaction and the meanings are created in conversations with others, the stories are jointly constructed and require collaboration and negotiation for their completion. He suggests that in this way,

Members of a culture create a shared interpretation of experience, each confirming, modifying, and elaborating on the story of the other....In this sense, the reality each one of us inhabits is to a very great extent a distillation of the stories we have shared, that are drawn upon in everyday conversation, in our perpetual attempts to understand the world in which we live and our experiences in it (p. 195).

Wells (1986) believes that the stories individual children construct in conversations with others are significant because the stories have roots in the perceptual and cognitive processes through which sense is made of all experience. He believes that each act of recognition, whether it be of objects in the external world perceived through our senses or of a conceptual relationship "seen" through an act of the mind, involves a sort of inner storying, and that this is how we make sense of it.

Shapiro (1994) echoes Wells' assertion for she believes that "every child attempts to make sense of the world, each in a unique and personal manner" (p. xx). Wells' metaphor of children as active meaning-makers is apt for he points out that

Rarely if ever do we have all the necessary visual or other sensory information to decide unambiguously what it is we are seeing, hearing, or touching. Instead we draw on our mental model of the world to construct a story that would be plausible in the context and use that to check the data of sense against the predictions that the story makes possible (p. 195).

A central tenet of the constructivist philosophy is that knowledge cannot be transmitted unilaterally from one individual to another. Wells (1986) explains that knowledge has to be constructed afresh by each individual on the basis of what is already known and by means of strategies developed throughout the individual's life. He echoes Bateson's (1994) constructivist perspective on problem solving, that "people arrive as strangers at the moments of crisis having to improvise responses based on previous experiences" (p. 27), when he explains that "storying is the most fundamental way of grappling with new experience...in the tackling of each new problem" (p. 205).

Wells emphasized the importance of children's stories and their role in education, a role that he believes goes far beyond their contribution to the acquisition of literacy. He maintains that impromptu stories not only provide a major route to understanding but

also assist children in making connections between what they are learning and what they already know. Wells (1986) argues that

Constructing stories in the mind—or *storying*—is one of the most fundamental means of making meaning; as such, it is an activity that pervades all aspects of learning. When storying becomes overt and is given expression in words, the resulting stories are one of the most effective ways of making one's own interpretation of events and ideas available to others (p. 194).

Wells believes that stories and storying are relevant in all areas of the curriculum because, through the exchange of stories, teachers and students can share their understandings and bring their mental models of the world into closer alignment.

Summary

The researchers in this literature review have become my “silent partners” in the “Catch of the Day” case study as they have shared some important findings and background assumptions about the nature of learning in informal social contexts. These “silent partners” outlined criteria for effective exhibits and informal environments for learning that support my rationale for using a marine float as a context for informal learning. Their research findings also provided me with insights about the research questions that I asked and the methodology that I used in conducting the present study.

A review of the literature on informal learning, constructivism, and situated cognition also provides analogies to the children's fishing experiences and interactions, from which I could make inferences and interpretations. An analogy could be made to the social and recreational context of fishing as an example of an authentic learning context, for, as Lave and Wenger (1991) point out, “Learners participate in the actual practice of an expert, but only to a limited degree and with limited responsibility for the ultimate product as a whole” (p. 14). The practice of the community (in this case study, fishing with friends off a float) creates the potential “curriculum” (understanding key concepts in marine education such as fish bait preferences and the interdependent nature of float

ecosystems), that may be learned by novices with legitimate peripheral access in authentic contexts. From insights acquired through the literature review, I could make inferences about the relationship between perceptions, learning, and problem solving experiences in authentic social contexts such as the present study's fishing activity.

CHAPTER 3: METHODOLOGY AND ANALYSIS

The facts are really not at all like fish on the fishmonger's slab. They are like fish swimming about in a vast and sometimes inaccessible ocean; and what the historian catches will depend partly on chance, but mainly on what part of the ocean he chooses to fish in and what tackle he chooses to use. These two factors being, of course, determined by the kind of fish he wants to catch. By and large, the historian will get the kind of facts he wants. History means interpretation.

E. H. Carr (1967)

Research Methodology

Lincoln and Guba (1985) argue that paradigms imply methodologies. The theoretical paradigms of constructivism and situated cognition underlying the study are congruent with a naturalistic paradigm and have implications for the choice of methodology that I employed in my research. The constructivist view of learning, the nature of the focus questions I initially asked, the authentic context of the study, and my assumptions about the nature of informal learning determined the most appropriate design and methods to use. A qualitative inquiry such as the present study of children's learning in marine education in an informal setting suggested a reflective, emergent research design and the use of a variety of qualitative research methods such as interviewing, participant observation, and visual methods using a video recorder.

Since the "Catch of the Day" case study is concerned with understanding children's learning and perceptions in an authentic social context, rather than determining their learning outcomes, answers to the initial focus questions of the research could be seen, as Carr (1967) vividly describes, as "fish swimming about in a vast ocean" rather than lined up neatly on a fishmonger's slab. As experienced fishing enthusiasts would say, the kind of tackle one uses and how it is used determines the kind of fish that can be caught. From an "ocean" of lived experiences, the "fish" I hoped to catch as research data depended partly on chance, but mainly on the decisions I made about what kind of fish to catch (data), what part of the ocean to fish in (context and focus questions), and what "tackle"

to use (methods).

To catch elusive fish, a fisher needs to make spontaneous, intuitive decisions based on tacit knowledge and experience as to what fishing tackle or strategy to use or adapt in order to be successful. The metaphor of the intuitive fisher is analogous to the metaphor of the qualitative researcher as “bricoleur” as described by several researchers:

The multiple methodologies of qualitative research may be viewed as a *bricolage*, and the researcher as *bricoleur* (Denzin & Lincoln, 1994, p. 2).

A *bricoleur* is a “Jack of all trades or a kind of professional do-it-yourself person” (Lévi-Strauss, 1966, p. 17).

The solution (*bricolage*), which is the result of the bricoleur’s method, is an emergent construction (Weinstein & Weinstein, 1991, p. 161).

that changes and takes new forms as different tools, methods, and techniques are added to the puzzle (Nelson, Treichler, & Grossberg, 1992, p. 17).

The determined fisher is also, in effect, a bricoleur, using knowledge gained from experience, tacit knowledge, and the specialized tools in a fishing tackle box to solve the challenging puzzle of catching fish. The fisher is like Denzin and Lincoln’s (1994) qualitative researcher as bricoleur because the fisher also

uses the tools of his or her methodological trade, deploying whatever strategies, methods, or empirical materials as are at hand. If new tools have to be invented, or pieced together, then the researcher will do this. The choice of which tools to use, which research practices to employ, is not set in advance. The choice depends on the questions that are asked, and the questions depend on their context, what is available in the context, and what the researcher can do in that setting (p. 2).

Thus, the research methods I used in the “Catch of the Day” study are effective ones selected from several approaches to qualitative inquiry. Although I have used a case study approach to design my research, I have also dipped my net into the field of ethnography, employing methods that would help capture a portrait of the groups of fledgling fishers as apprentices with legitimate peripheral participation in a culture. I observed children’s verbal and non-verbal behaviours on the float and recorded my emerging perceptions and reflections.

I used visual methods as another approach to qualitative inquiry in this study to help me cast a wider net. An assistant on the dock's ramp video-recorded, as unobtrusively as possible, the fishing activity. The videotapes provided the children as well as me with opportunities for reflections on and for vicarious revisiting of the fishing experience. Like binocular vision, the videotapes offer depth to the study by providing a second point of view to the fishing activity on the float.

Additionally, I engaged the children in conversations at the site to encourage them to verbalize their thinking-in-action, their intentions, and their perceptions. The following day I conducted informal conversational interviews with the children as they viewed and reflected on excerpts of the fishing videos. Inviting the children to reflect on their fishing activity is a qualitative method drawn from the field of phenomenology. I endeavoured to get as close as possible to the children's perceptions of their experiences in order to retell their stories from their point of view as narratives, or "Fish Tales."

I gathered data for the "Catch of the Day" case study from two events. For Event I, I utilized another qualitative inquiry method. I acted as a participant observer among each of five separate, small groups of children fishing while an assistant videotaped the activity from the ramp. For Event II, I interviewed the children while they watched and commented on the videotape of their fishing activity. My assistant also videotaped these interview sessions. I made transcriptions of the audio portion of the videotapes. The voluminous transcriptions provided a base to develop "thick description" (Geertz, 1973) in writing my narratives, another approach to qualitative inquiry. Following the interviews I gave the children paper and pencils and invited them to draw as another way to reflect on their fishing experience.

Through participant observation, visual methods, informal interviews, children's drawings, and reflections, I was a bricoleur. I used many qualitative elements (ethnography, conversational interviews, phenomenology, personal experience, and narratives) as I wrote this "Catch of the Day" case study.

The Setting

I conducted the "Catch of the Day" case study at my private waterfront property located on Sechelt Inlet, B.C. I selected a marine float for the first event, the fishing activity. The float is approximately six square meters in area and is used for mooring small pleasure craft. The float is connected to the dock on shore by a wooden ramp with handrails. I chose this particular site to observe children fishing as:

- it was convenient to use and there is no access problem (my residence),
- washroom and refrigeration facilities (for keeping bait and refreshments cold) were on the research site,
- the float is located in protected waters in Sechelt Inlet, some distance away from float plane and marine boat traffic, so providing a safe working area for children,
- perch and rock cod are abundant beneath the float during the summer months, increasing the likelihood that children would be successful fishing,
- it is a natural setting for learning informally in science, especially marine education, and it provides an authentic context for learning how to catch fish,
- the float has an established marine ecosystem beneath it: the thick ropes purposefully left dangling from it for two years are encrusted with a variety of marine life that offer the children a smorgasbord of bait types from which to choose,
- the rocky shoreline with its tidal zonation offers children a visible contrast to the float's ecosystem,
- an abundance of marine life is visible (e.g.: perch, rock cod, sea cucumbers, crabs, seals, blue herons, kingfishers, eel grass meadows, kelp beds, and sea gulls),
- it is in a sunny location where children can clearly see their baited hooks and fish activity in the water around and beneath the float, and
- it is a private area so the children would not be distracted by the activity of other people.

The marine setting is typical of the coastal waters of southern Georgia Strait, however the float itself is unique because of the dangling ropes that I added for the explicit purpose of creating a surface area to which marine organisms such as mussels could adhere. I thought that a rope encrusted with mussels and other organisms would attract fish such as perch to the float and increase the likelihood that the children would be successful in catching fish. (See Appendix B for the natural history of three species of perch usually seen at the research site in late summer.) The float setting offered the children an environment where they could explore and investigate natural marine phenomena. It was also a setting where children could bring their own learning styles and experiences.

I selected my home for the second event, the interview. At this site, the children (as well as their parents) could gather around a large screen television with a VCR to watch the fishing activity video and answer conversational interview type questions in an informal manner. I conducted the interview sessions the day following the fishing activity so that I could preview the video and prepare a list of open-ended questions that would reveal the children's thinking and reasoning behind their specific actions and their perceptions of their fishing experience. I made transcripts of the fishing and interview videotapes using a word processing program on the computer in my home office.

The Participants

The research involved five small groups of children engaged in learning how to catch fish off a marine float. Twenty one children, ages 6 to 14, participated as multi-age heterogeneous groups of three, four, or five children. There were eleven girls and ten boys. To ensure the confidentiality of the children, I replaced their names with pseudonyms. I acted as a participant observer among each of the small groups of children, while another adult was present at the site videotaping the fishing activity from the ramp.

Selection of participants and representativeness of the sample is a dilemma for researchers. The children were not randomly selected for the study and they had varying degrees of exposure to fishing experiences. However I have found, through personal experience, that even if children had prior fishing experience most of them have much to learn about the appropriateness and suitability of various line, hooks, rods, and bait types when trying to catch fish. Safety of the children was my prime concern, so I selected boys and girls who:

- represent a range of age levels (6 to 14 years),
- expressed an interest in learning how to catch fish,
- enjoy explaining their thinking to each other and to adults,
- demonstrated responsible as well as collaborative behaviour and a concern for safety,
- have parents who were willing to remain on the research site as a safety precaution.

The composition of the study groups is shown below:

Group 1: girl, 9 years; girl, 12; girl, 14; boy, 12 ; boy, 14

Group 2: girl, 8 years; girl, 8; boy, 10 ; boy, 11

Group 3: girl, 6 years; boy, 7; boy, 7; boy, 7; boy, 9

Group 4: girl, 8 years; girl, 9; girl, 10; boy, 14

Group 5: girl, 7 years; girl, 9; boy, 10

Since the children were known to me, they were aware of my profession as a local science teacher. This knowledge may have influenced the children's behaviour on the site. However, as the intent of the my research was to study children's interactions in a social context so that implications may be revealed that may inform my classroom practice, I was very interested to observe how children interacted with me as a participant observer on the float in an informal setting, so that these interactions could be compared to interactions that

I previously observed as their classroom teacher in a formal school setting. Prior to the study I observed that when children become immersed in fishing they become unconcerned with and often oblivious to the presence of adults and video recorders.

The Researcher As Participant Observer

As part of the qualitative researcher role, I became a participant observer on the float with the children as they fished for perch and rock cod. I told the children that I really enjoy fishing with friends, especially with children, and that I was interested in learning more about how small groups of children learned to catch fish. They perceived my role as a fishing enthusiast helping them by demonstrating angling techniques on the float, getting fishing hooks, rods and bait ready to use, showing how to put bait on the hooks securely, and untangling lines.

I perceived my role as a facilitator on the float providing exhibits such as fishing equipment and encrusted ropes that invite manipulation and investigation; as an observer of children's verbal interactions and non-verbal behaviours; and as a catalyst asking questions to open up conversations and invite investigations rather than probing for "right answers." My purpose was to assist children when necessary, answer their questions when asked, provide resources, and invite the children to verbalize as they fished using open-ended non-directive questions.

The Materials

I made a variety of commonly used fishing equipment/resources available on the dock for the children to use in this study:

- several fishing rod types with different casting, trolling, and mooching reels,

- different sizes and types of hooks (small single-barbed bait-holder hooks, two treble hooks on a leader line called a “salmon hook-up” or “herring hook-up,” and a large treble hook used with a buzz-bomb lure),
- different colors and types of line on reels (clear and blue monofilament, and braided black cord),
- small custom-made wooden holders for hand-lines, and
- different bait (herring, mussels, and other organisms on the encrusted ropes).

These choices gave the children opportunities to actively participate, through manipulation of these interactive fishing exhibits, in the discovery of scientific principles and concepts. I was interested in knowing how children learned to choose tackle appropriate for successfully catching the type of fish available under the float.

The Events

I gathered qualitative data for this study for both Event I (the fishing activity experienced separately by five different groups of children) and Event II (the small group interview conducted during and after watching a videotape of the fishing experience) during September, 1995. The children participated and were videotaped in the following events:

Event I: The Fishing Activity

I invited five groups of children, one group at a time, to fish off a marine float. I was a participant observer among the children as they fished helping them when needed and posing open-ended questions about their experiences. Another adult videotaped the fishing activity and conversations as unobtrusively as possible from the ramp connected to the float and dock. The children's verbal interactions and non-verbal behaviours were

observed from my point of view as well as from the assistant's vantage point on the ramp while videotaping the proceedings.

The intent of my observations was to determine how the children made choices about the fishing equipment offered, how they used these resources, what they noticed about the marine ecosystem and fish behaviour, what problems they encountered and resolved, what they learned from each other, and how they interacted with each other as they fished. These observations together would reveal clues to the children's perceptions of the fishing experience. These activities also reflect my belief in the importance of collaborative, learner-centered experiential programs in science education. Each fishing activity lasted approximately two hours.

Event II: The Small Group Interviews

The children (and their parents) were invited to my home the day following their fishing experience to watch the videotape of themselves fishing. As they watched, I encouraged the children to comment on aspects of their experience. I used the remote control device's pause button to "freeze" the action on the videotape when the children wanted to offer their comments about incidents in the fishing activity. I posed questions informally during conversations with the children to clarify some of their fishing strategies, to reveal the thinking and intentions behind their actions, and to elicit the children's perceptions of fishing. The small group interviews I conducted during and after watching the videotapes lasted approximately an hour. An adult assistant videotaped the proceedings as unobtrusively as possible from a corner of the room in order to eliminate the formality of me taking notes during the informal conversations.

While the children enjoyed refreshments after the group interview, I invited them to gather around a large table and draw a scene from their fishing experience. I gave the children drawing paper and assorted colored pencils to use. Drawings reveal tacit knowledge that might otherwise go unnoticed in the study. I told the children that the

drawings would help me understand more about what they learned while fishing. As the drawings were completed, the children “hung” them with magnets on my refrigerator. (See Appendix C for examples of children’s drawings.)

Data Analysis

The records of the study include the videotapes from Event I and Event II for each of the five groups of children, and my computer data-base notes of personal observations and reflective notations as a participant-observer. From each videotape for Event I (the fishing activity) and Event II (the small group interview), I made the following representations of the data:

- I transcribed the verbatim talk of the children in each activity using my computer’s word-processing program and the “pause” button on the VCR’s remote control device. (See Appendix D1 for the transcription of Event I, the fishing activity; See Appendix D2 for the transcription of Event II, the small group interview.)
- I recorded the children’s non-verbal behaviours as anecdotal comments beside their verbatim talk for each computerized transcription.
- I replaced the children’s names with short pseudonyms.

I conducted the following levels of transformation for each videotape and transcription during the data analysis:

Level 1: Clandinin and Connelly (1994), in their discussion of personal experience methods, state that “people by nature live storied lives and tell stories of those lives.”

From the computerized transcriptions of Event I, I used the computer’s word processing program and “Cut and Paste” functions to isolate the verbal and non-verbal behaviours of particular children. I recorded these behaviours in the form of a running

narrative, or vignette, for each child, and I used the narrative to order as well as represent experience with the intent of revealing a perspective of fishing from the child's point of view. This transformation formed the frame of the child's "Fish Tale," and gave a narrative, story-like quality to the child's struggles to be successful in learning how to catch fish. Louden (1989) argues that it is important for stories to be contextually-rich so that readers may experience "an intuitive sense of what it was like to be there" (p. 57). I created three children's Fish Tales from the fishing activities, each one providing readers with a vicarious experience as armchair fishing enthusiasts. (See Chapters 5, 6, and 7 for the three individual Fish Tales.)

- Level 2: I chose the Constant Comparative Method of Qualitative Analysis, described by Glasser and Strauss (1967), for my data analysis as it outlines a useful scheme for categorizing the kind of data I collected in the present study. Researchers using this method begin by coding each incident in the data into categories, as categories emerge, or as data emerge that fit an existing category. After coding, incidents applicable to each category are compared. For each category, rules or properties are defined that characterize each category.

From each of the computerized transcriptions of Events I and II, I categorized the children's verbal and non-verbal behaviours in my computer's data base, rather than using old-fashioned file cards, according to Feher's (1990) four levels of engagement in learning: experience, explore, explain, and expand. Although I was aware of these *a-priori* categories, my intent was to determine if the children did "expand" or extend their engagement in the fishing activity, how they did so, and if there were any other relevant categories possible to add to Feher's list. Categorizing incidents into Feher's four levels of engagement in learning, and others as they emerged, is an example of the constant comparative method of data analysis that is an appropriate analytical framework for this case study and very effective in determining how children shared

their fishing experiences. (See Appendix E for the children's levels of engagement in learning.)

- Level 3: I used the Level 1 and Level 2 analyses to answer the three focus questions of the study. An interpretive commentary follows each Fish Tale, from my point of view as the researcher. From a constructivist perspective, meaning is constructed and does not emerge from the data itself. Rather, the meaning derived from the data is a subjective interpretation that I have imposed on the narratives. I made inferences about the social dynamics of the groups, their cognitive and affective learning outcomes, their perceptions of fishing, and implications for classroom teaching practices.

Limitations Of The Methodology

Just as the amount of line on a fishing reel limits the range and depth at which one can catch fish, there are certain limitations in qualitative research such as the present case study. This study had some elements that were beyond my control, and these uncontrolled factors may have influenced the data outcomes. The following is a list of such limitations:

- Wind on the float, wasps buzzing around the video recorder's microphone, noisy boats passing by, and their wakes which caused the float to creak as it moved up and down were all factors that caused difficulty in obtaining clear sound on the video recordings. This made complete transcriptions of verbatim talk difficult.
- Several children and adults all talking at the same time and at various pitches and volumes caused some difficulty in transcription. Although the participants were confined in a small area on the float, the microphone on the videorecorder clearly captured the voices of the participants visible within the viewframe of the lens, but the voices of participants outside this range were hard to hear. Thus, the direction that the microphone pointed affected the results captured on the audio portion of the tape.

- The battery pack on the camcorder expired earlier than expected in the first fishing session, reducing the amount of videotaped interactions on the float. An electrical extension cord was available when needed for the other four fishing sessions.
- Some of the parents made comments and gave directives to the children while they video-recorded the events from the ramp, while some parents were silently unobtrusive. The comments and directives may have influenced the children's social and investigative behaviour.
- Because of the hot weather, the wasps were attracted to the smell of thawing herring bait and crushed mussels on the float. The wasps made their presence felt by stinging two of the children as well as me. As a result, the focus of our attention during conversations shifted abruptly from the fishing activity to relieving pain.

Establishing Trustworthiness

One doesn't go fishing if the weather forecast is unfavourable. Likewise, a good researcher doesn't conduct the research if an initial scan of the study suggests that its validity is questionable. The trustworthiness of this qualitative study was established according to Lincoln and Guba's (1985) definitions of credibility, transferability, dependability, and confirmability, criteria they believe are more fitting for naturalistic research such as this case study.

To resolve credibility issues, Lincoln and Guba (1985) recommend using triangulation, a research approach that analyzes the data gathered from a number of points of view. Rather than jumping to conclusions, I was able to guard against biases in the study by using triangulation as an alternative to validation methods. In the study, I verified the findings and increased the credibility by analyzing and triangulating the data from three sources: personal notations of observations as an active participant observer on the site,

videotapes taken by an assistant from a second vantage point on the ramp, and follow-up small group interview sessions with the participants.

In addition to the data base notations of personal observations and reflections, I made verbatim transcriptions of the assistant's videotapes for later analysis. This was an important process as a review of the fishing activity videotapes, for analysis, made me aware of some children's learning "moments" that I had missed while I was engaged on the site with other children. Like the expression "you can't see the forest for the trees," I missed critical parts of the study by being so close to the fishing activity. To resolve this gap, I conducted informal conversational interviews the next day with each group of children as they reviewed their fishing videotape. During these open-ended conversational interview sessions, my intention was to clarify the perceptions and inferences that emerged during previews of the tapes. Using probing questions, I established credibility by cross checking my personal perceptions, inferences, and interpretations with the subjective perceptions of the participants.

An aware researcher would point out that it is important not to make assumptions about children's learning or their personal interpretation of events. Like Baron (1993), I also believe that experiences are perceived and shared differently by each individual. Because so many factors such as personality characteristics, background history, feelings, and peer group social dynamics are involved, it is difficult to know precisely what kind of learning experience a child is having or what kind of perceptions they generate about their experiences without these purposive follow-up interviews. In these interviews, the participants' own language provided a form of member checking, often echoing their statements. This strategy was a good method to validate or modify my observations. The use of a variety of forms of feed-back methods such as on-going conversations on the site and informal conversational interviews using probing questions as a follow-up session result in a deeper exploration of children's perspectives and understandings.

After fish are caught they must be cleaned and analyzed for edible parts. The process of data analysis in the study involved a similar inspection, for my intention was to review the data looking for emerging categories, patterns, and relationships as well as clues to the children's perceptions of fishing. I also sought evidence of children's learning in cognitive and affective dimensions. Erickson (1986) suggests that qualitative researchers should make a note of the aspects of what occurs that are unique to that particular event and to particular individuals in it. He believes that the task of analysis is

to uncover the different layers of universality and particularity that are confronted in the specific case at hand—what is broadly universal, what generalizes to other similar situations, and what is unique to the given instance (p. 130).

The data analysis in this study involved making inferences about children's learning, however the intent of my research is not to seek generalizations from the study to other cases as is the norm in quantitative research. Eisner (1981) argues that

Artistic approaches to qualitative research have no comparable mechanism for generalization...but try to locate the general in the particular. They attempt to shed light on what is unique in time and space while at the same time conveying insights that exceed the limits of the situation in which they emerge....The artistically oriented researcher is interested in making the particular vivid so that its qualities can be experienced and because he believes that the particular has a contribution to make to the comprehension of what is general (p. 7).

Thus, the criteria of transferability is not applicable to this qualitative case study. There is no intent to generalize the results of this research to other populations of children. However, some of the findings of this study may offer insights into naturalistic case studies conducted in other informal contexts.

I established dependability and confirmability by using different research methods that leave an audit trail such as interviews and videotape transcriptions. The audit trail for this study provided evidence to support my emerging and progressive inferences made from the transcriptions to the fish tales to the interpretive commentaries.

Rationale For Using A Video Recorder

Using a video camera to record observations is problematic for ethnographic researchers, as its presence on the site may influence children's responses and behaviours, at least initially. Lucas and McManus (1986) describe these behaviour changes as "playing to the gallery" (p. 345). I have noticed that older children are more aware of being video taped and may become self-conscious. Younger children tend to forget the presence of video cameras after a while, especially if the activity lasts two hours. This could be due in part to the fact that video recorders are being used more often in primary classrooms to show parents glimpses of their child's learning during report card conferences, and video recorders are becoming as common as TV sets in many homes so children are used to their presence.

I explained my rationale for using a video recorder to the children and their parents. I told the children that it would be fun to get a video tape of them fishing off the float to look at later with juice and cookies. I also told them that I could learn a lot by watching the video tape to see how they learned how to fish. I asked the parents if they would operate the video camera and focus on the children engaged in activity and social interactions, as I was interested in learning more about how children learn in a social and recreational environment.

I used the video tapes of the fishing activity for clarification and interpretation purposes and to generate a list of possible interview questions and probes. Reviewing a videotape of children's behaviour in an informal learning environment such as a marine float and carefully analyzing transcriptions can reveal much about the children's thinking processes, the strategies they used to solve problems, their misconceptions, and how the social dynamics affects their thinking and learning. Audio-visual recordings of the events also permit vicarious revisiting (Erickson, 1986) so that an in-depth understanding of the participants' behaviour patterns and perceptions can be discerned.

Summary

The naturalistic methodology outlined in this chapter is a fruitful way for me to gather as well as organize the data in the "Catch of the Day" case study. Children's perceptions are like Carr's (1961) "fish" swimming about in a vast and sometimes inaccessible ocean. Casting a net to reap their perceptions depends on chance: the nature of the group, their immediate experiences, their prior knowledge, as well as the variable environmental conditions of the day. The "Catch of the Day" study will of course haul in an amorphous pile of data, fish for the fishmonger's slab. Feher's (1990) categorical scheme is a useful tool for me to use in sorting through the pile, in the process of data analysis, and as a guide in facilitating meaningful interpretations.

CHAPTER 4: INTRODUCTION TO DATA PRESENTATION AND INTERPRETATION

We make the assumption that experience is both temporal and storied.... When persons note something of their experience, either to themselves or to others, they do so not by the mere recording of experience over time, but in storied form...Stories are the closest we can come to experience as we and others tell of our experience.

Clandinin and Connelly (1994, p. 415)

Fish Tales

Conversation with and among the children has been the main source of the data I collected in this naturalistic study. I present the gathered data from one group of three children, from Event I (the fishing activity) and Event II (the follow-up interview), in the following three chapters in the form of lengthy descriptive narratives. These "Fish Tales" reveal the individual perspectives of one social group's shared fishing experience. Three Fish Tales are told, each Tale capturing an individual child's distinctive point of view. My perspective as researcher, participant observer, teacher, and fellow fisher, revealed in the interpretive commentaries following each Fish Tale, adds a fourth point of view.

One of the assumptions of qualitative research is that no single truth is waiting to be uncovered. There are multiple perceptions of truth. Just as the ocean is a multi-layered medium with each layer unique in its physical characteristics and variety of sea life, so are the children's physical and social interactions in the fishing activity. Each Fish Tale is a mini-case study, in storied form, of the subjective meanings that the individual children make of their experience, and the unique perceptions they reveal about fishing. Van Manen (1990), a strong advocate for the child's voice to be heard in research, believes that to be oriented to the lifeworld of the child in research is to discover what a particular experience is like for that child. Each Fish Tale allows the reader to see not only the child, but also the person. Their stories tell, with "thick description" (Geertz, 1973), what they experienced and explored and how they shared their experiences through explanations and the use of analogies.

The constructivist paradigm assumes that there are multiple perspectives. For every fishing experience there is always “a fish story” and multiple versions of it seen from the viewpoint of others present. The constructivist paradigm also assumes that the multiple realities are socially constructed and holistic. Without a social context, there can be no stories to tell. Within the social context of fishing, the stories are constructed through the sharing of experiences and are a holistic blend of sensory, perceptual, and conceptual experiences. I used my personal sensory experiences as a participant observer in the study to describe what I believed were the children’s sensory and perceptual experiences.

Lincoln and Guba (1985) argue that naturalistic inquiry always diverges rather than converges, and divergence is evident in the development of perceptions, experiences, explorations, explanations, and problems in the Fish Tales. As each child tries to make sense of the fishing experience, each does so in a personal and unique manner that is story-like in quality. Each of the three Fish Tales presented in the study tells a different story, although the Tales were all created in the same time and place for each of the three participants in one fishing activity.

Each of the three Fish Tales is followed by an interpretive commentary that expresses my point of view as a participant observer. Erickson (1986) points out that for each narrative vignette there is much more semantic content in the text than can be seen at first reading by the audience. Thus, the commentaries describe details that are salient for me in reflecting on the experiences, explanations, and interactions in the study and in deriving meaningful interpretations. I have personalized the three children’s Fish Tales with descriptive titles as follows:

Fish Tale #1: Kate The Frustrated Fisher

Fish Tale #2: Jill The Playful Fisher

Fish Tale #3: Mike The Experienced Fisher

Levels Of Engagement

Following each child's Fish Tale and my interpretive commentary is a descriptive summary of the different levels of engagement in the fishing experience that the particular child reached. I have listed specific examples from the data under each level. Appendix E presents the data in a table format so that comparisons can be made among the three children for each level of engagement in the fishing activity.

Feher (1990) describes the science learning process as an experiential, exploratory, and explanatory process, where the children first undergo an experience in which they can actively participate and then they give meaning to the experience through their own interpretations and explanations. Feher's research with interactive museum exhibits examined the intuitive notions that children bring to novel situations and how these shape their interpretations of the phenomena which the children observe and manipulate.

She found that

Users learn subject matter and process. If we examine the exhibit as a teaching device, we can distinguish several different levels of engagement with exhibit phenomena:

- Experiencing: The exhibit shows that certain phenomena occur in nature. This experience is perceptual, sensory, and driven by aesthetic curiosity.
- Exploring: The user discovers new features of the phenomena by manipulating the exhibit. This active exploration serves to integrate and internalize the sensory and perceptual discoveries that are being made.
- Explaining: The users are explanatory beings who form mental models or theories to explain what they experience. This is a conceptual level.
- Expanding: Users generalize ideas through active involvement with other related exhibits. Connections are made to similar phenomena (p. 46).

In the fishing study, I classified the children's activity according to Feher's (1990) four levels of involvement in order to: (a) determine the effectiveness of the fishing "exhibits" and context in engaging the children in learning, (b) determine the level of engagement reached by the children, and (c) determine the relationship between the children's perceptions of the fishing experience and their levels of engagement in the activity. Feher's belief that people learn by doing, playfully interacting with exhibits,

was demonstrated by each of the children in the present study as they actively engaged in playful exploration on the float in learning how to fish and sharing their strategies with others. The children experienced what a hooked fish felt like on the line, they explored how to open a mussel and get the flesh to stay on the hook, and they explained their techniques for being successful in catching fish.

I created sub-categories to Feher's levels of engagement in learning: experimenting (where the child's explorations involve planning investigations), teaching others (where the child's explanations have the intent to teach others), and empathizing (as a perceptual sub-category of experiencing). I used "extending" in the present study instead of Feher's (1990) level "expanding," because extending more clearly suggests, for me, the making of connections to similar phenomena, whereas "expanding" suggests spreading out or enlargement in size.

CHAPTER 5: KATE'S FISH TALE

Kate The Frustrated Fisher

The hot afternoon sun beat down on the deck of the float as ten year old Kate headed towards it with her two friends. She carried a fishing rod and reel and began to "fish" off a corner of the float with a bare hook on her line. "Oh, one of the fishes is at mine, a little one. He wants it but he can't bite it."

"That's because we have no bait," explained Jill, who was also "fishing" off the edge of the float with a bare hook.

"I know. If it had bait..." she replied, looking up to see me returning with the promised bait. "I had a whole bunch of them. When I bring it up they're not there."

"I have some herring here, but I wonder what else perch eat?" I asked the children as I opened the bag of bait and handed Kate a frozen herring.

"I don't know," replied Kate. "Can I just cut like a bit off, a little chunk? I'm going to try to cut off a little piece." Kneeling on the float's deck boards, she carefully cut a cross-section from the frozen herring's mid-section and then showed her herring "steak" to the video camera for a close-up. "Ummmmmm. Yummy, Mike, doesn't that look yummy?" she said to her friend who was casting his buzz-bomb lure out from the float. The herring's frozen entrails were visible as a dark red circular section enclosed by the herring muscles and skin.

"That's a fish fillet! A herring fillet!" I chuckled.

"We got it on but it's not very secure," she commented as she lowered her baited hook and line into the water. A little later she had trouble bringing her line in. "Hey, which way do you bring it up? Um, which way do you bring it up? I forgot." I showed her how to turn the reel the opposite way and she brought her line in.

"See?" she said pointing to her baited hook. "They all got a big chunk out of mine. It's missing." The herring steak had flesh and skin intact, but the frozen entrails were

missing, leaving a visible hole. "See? They won't hold on but they can eat it. Then see? There's a big chunk out of it."

"So what are they doing?" I asked, looking at the hole in the steak.

"They're just nibbling at it and then they won't hold on."

"Just one at a time? or?" I probed.

"Yeah, see? Look! See the hole?"

"You've got to go deeper," advised Mike as he listened to Kate's problem.

"You've got to get deeper, then you'll catch them."

"They're all there," she said.

"So, is it just one fish at a time trying to get it, or?" I queried.

"They're all there," she repeated.

"So they're all there," I echoed. "They're all trying to get it at the same time?"

"So are they all trying to get it for themselves, or? How many do you see?"

"Ten or fifteen," she counted as she peered over the edge of the float.

"So, do you think they're fighting with each other, or are they helping each other?"

"Maybe...I don't know. Maybe they're fighting," she decided hesitantly.

"Or helping," added Mike, "because..."

"Maybe they could share it," she added, quickly changing her mind about the fish's behaviour as she heard Mike's comment. "Because of that big chunk that's missing, they probably all got a bit."

"Do you think one fish can get it off by itself?" I probed.

"Probably not," she replied. "I'll try a different spot. I tried it on this side but they keep biting but they never get snagged. Maybe you want to get a shot of this," Kate suggested to her mother on the video camera as she brought the baited hook close to the camera lens. "Something different. See the difference? See? That's what they did. They've made a little hole."

"Oh, they've made a little hole in there, so you think the fish are just eating it

away?" I asked, wondering if she would speculate on why the perch were eating one part of the herring bait but not the other.

"Umhum. I keep trying to get 'em out but they always move away."

"You're supposed to try and snag 'em," advised Mike as he continued to cast.

"But then again, fishing does take patience," she replied, as she lowered her baited hook into the water again.

"So, how far down do you have to be to catch a fish?" I asked.

"I don't know. Maybe the bigger ones might be at the bottom," she suggested.

"The bigger ones may be at the bottom," I echoed. "And the little ones would be?"

"Maybe more at the top?" she queried uncertainly.

"I wonder why that would be?" I asked.

"I don't know," she repeated. "I guess they're maybe smart fish 'cause they can't seem to....I keep forgetting which way to reel it in." She struggled for a moment then turned the reel the opposite way to bring her line in so she could check her bait.

After seeing Mike using crushed mussels as bait on his line, Kate opened one, added it to her herring-baited hook, and continued to fish. "They're not going to snag on," she complained. "There's a whole pile over here. See? That fish has got away with some of the mussel and they're never gonna...See? They got the mussel off and....one was caught but he got off. See? He was snagged by his lip but then it must have ripped through."

"So, which are they going for, the herring or the mussel?" I asked as I helped her bait her hook again.

"They were all at the mussel and they took it all off and one got away with most of it," she explained. "They're all over there feasting. They're never gonna...They haven't seemed to find the hook to snag on." She brought her line in to bait her hook again. "I'm going to try some more mussel because that's what attracted most of them, and one got snagged. The one you had on here was perfect."

"Let's see if we can find another one," I said as I hauled a mussel-encrusted rope out of the water onto the deck of the float. "Do you notice all the mussels on here? But take a look at the shoreline. Do you see any mussels at all?" I asked, pointing along the rocky shoreline which is covered with seaweed but obviously lacking blue mussels.

"No," she replied as she looked at the shore with a furrowed brow.

"I wonder why?" I asked as I plucked a few large mussels from the rope.

"Maybe they like living underwater better," she suggested.

"Underwater?" I repeated, puzzled. "Do you see any underwater over there?" I asked pointing to the lower tide zone along the shoreline.

"Not really," she replied. "Maybe they like to live on...I don't know." She resumed the business of opening mussels. "I think I'll just stick the whole thing on."

"So what do you think would eat mussels?" I asked the children as a group.

"Oh, they all do," answered Kate quickly. "They all came and grabbed it right off the line. So that's why I'm trying more. See? They're all after it. That one guy just got it all. He was snagged on it. See? He just took the whole thing. See that?"

"Well, what would happen if you jerked it?" asked Kate's mother on the camera.

"Well, maybe I'd snag 'im," she answered. "I'll go back and try it. Isn't that unusual the way they just took that all in a circle?" she said holding up her baited hook to the camera and pointing to the circular hole in her herring steak that once contained frozen entrails. "I'll try to get this on and get it back in." She got her hook caught in her sweater and I helped her to get unhooked. She held up her herring "steak" for the camera, clearly showing the circular hole where the missing entrails had once been. "Maybe it's the better part of it?" she suggested. "I'm going to take that thing because I'm going to try it again. I'm going to jerk it when the fish bites and maybe it'll snag 'em."

"So, you mean you're going to try mussels or..?" I asked.

"I'm going to have some more mussels," she replied indicating that she was going to add that to her herring-baited hook.

“What do you think pile perch eat?” I asked.

“Um, I don’t know,” she replied.

“Well, I just pulled the rope up here. Do you see the pile perch along the shore there?” I asked, pointing along the shoreline again.

“Um, no.”

“I wonder what they could be eating on here?” I probed further.

“Maybe mussels.” She resumed trying to bait her hook with mussels. “If I can get it (the mussel foot). It’s hard. I’ll try it again. Ahhh! It might be easier just to put it on the dock. Ooooh. That’s the foot,” she explained as she held the blob of mussel tissue close to the camera. “That’s where I was trying to hook it on, that part right there. Ha! I’ll just try it like that. It’s covered and so...” She showed her hook covered in mussel tissue. “Well, I’ll try it. Oh no, my thing is very mixed up here.” She was puzzled at her tangled line, so Mike came to untangle it for her. He then resumed fishing using an old rod and a reel that held a very old black cord line.

Mike quickly caught a perch, and Kate urged, “Oh, don’t kill him! I want to let him live. Whoops! I’m not watching my line.” She reeled up her bare hook. “You see? One fish stole it. Well, Mike got the first fish of the day. Are we gonna let him go? Don’t just pull it!” She said as she watched me using the fishing pliers to remove the hook from the fish’s mouth. Kate was horrified when the hook broke leaving the barb to remain in the fish. “So, the hook is still in him? Will it kill him?”

I realized that I had to think quickly to reassure the children that the fish would be all right. “No, it won’t because in the salt water...What happens to iron in salt water? Remember we did that steel wool experiment in school? What happened after a few days?”

“It rusted and it grew all this stuff on it,” answered Kate, referring to the fluffy white salt crystals that formed from the evaporating salt water. I assured her that the broken hook would rust and disintegrate too.

"The first catch of the day," Kate announced as she returned to baiting her hook. "I'm gonna load this hook up with mussels so I could catch one. Let's get the big sucker!" As she resumed fishing she turned to Mike to ask, "I put it more down there. Is that where you caught it? Was it really low?"

"Yeah," he replied, and then he advised her to "snag it."

"Those little guys are so annoying," she replied. She watched as Mike reeled in a second fish. She declared, "It must be the black line! Can I try a black line? I'm going to try a black line. I'm never gonna...I'm going to try a black line next." She traded rods with Mike, and he quickly caught a third fish on a clear monofilament line. "What? Again?" she asked. "We've got three fish caught by the same person," she counted. "What is it with Mike? He's just...but I didn't even catch a fish?" she complained.

"But this rod you were using didn't have a black line on it," I commented to Mike.

"Yeah, so it's not the black line," pondered Mike.

"Maybe it's just a streak of luck," suggested Kate. "Maybe it's the bait. Well, let's just see what this does," she commented as she lowered her mussel-baited hook on the black fishing line. "Maybe I'll try Mike's spot."

"Maybe it's the good fishing spot! Ha ha," I laughed.

"I never caught any," she grumbled.

"You have to jig it up and down," advised Mike, and seeing Kate's frustration and disappointment he came over to help her. "That's how I caught them."

When I announced that I have one more piece of mussel ready, Kate answered, "I'll have it! 'Cause I haven't caught any yet."

"Some days I've gone fishing and I haven't got anything and everyone else catches all the fish," I said to Kate, sensing her frustration. "And on other days, I've caught all the fish and no one else has got any. That's the way fishing is. Do you think the fish really care whose line it is? Give it a try," I said handing her the mussel tissue.

"Oh, there's a big one right there," Mike pointed.

"Where?" asked Kate. "OK, let's reel it down. Let it down, down, down... I felt something. I have to bring it up because I think I lost my bait. Oh shoot! It's all tangled there." Mike helped her untangle her line at the rod tip but the cord on the reel seemed tangled so I assisted him. While we were engaged with the reel problem, Kate remembered that Jill hadn't caught a fish either. "I bet if you put double time mussel on it Jill, you'd surely catch one," she assured her. Kate tried to resume fishing, but she had difficulty with the reel again. "This is backwards." She turned the reel's handle the other way and lowered her line again.

"Actually, reel it up a bit," Mike coached over her shoulder. "Reel up, reel up! There's a big one right there! Go over there. There! Stay there!"

"Oh! I got it! I got something!" exclaimed Kate as she reeled in a shiner perch at last. She released it with a grin and said proudly, "I caught a fish!"

Researcher's Interpretive Commentary

In analyzing social settings in qualitative research, Lofland (1971) asks,

What is problematic to the participants here? What are the things over which they fret, show irritation, or desperation? When they look out onto the world what appears to them as important, stressful, or difficult? (p. 54).

In this "Fish Tale" vignette, Kate arrived at the float with high expectations, as she looked forward to an enjoyable afternoon of fishing with her friends. However, she soon perceived fishing as a frustrating experience as the fish would not cooperate and "get snagged on" her baited hook as she thought they were supposed to do. "Those little guys are so annoying," she complained as she watched the fish congregating about her sharp baited hook.

Kate was puzzled because she perceived that the task of fishing could be broken down into a number of sequential steps—a recipe approach—such as: choose a rod with a weighted fishing line on a reel, cut a small piece of herring as bait, put in on the hook

securely, and then lower the baited hook in the water to where the fish were seen. She became frustrated as she believed that she had faithfully completed each "fishing" step in order, just like the lab experiments she previously conducted in science lessons, and that she should be rewarded with success, but the fish refused to get hooked.

Kate also perceived that fishing should include an extension of her notion of fairness. It was important to her that everyone should have a fair turn to catch fish. However, she was visibly frustrated at seeing her friend Mike catch three perch in a row while she lost her bait to uncooperative fish. She thought that if she copied her friend's fishing strategies she would surely be successful and catch the next fish. She asked to use the fishing rod with the black line since she observed that it was successful at catching perch for Mike twice in a row. She opened mussels, baited her hook with the slimy flesh, and was sure to put the hook through the mussel's muscular foot as I had suggested and demonstrated. Then she lowered her baited hook from the same spot on the float where Mike had been successful twice. Even with these careful strategies, she was frustrated for the third time at seeing Mike catch another perch right beside her baited hook. "What? Again?" she grumbled. "We've got three fish caught by the same person...but I didn't even catch a fish."

These kinds of interactions provoked puzzlement for Kate as well as frustration. Lucas (1983) believes that "when visitors can control the exhibit in some way, where interactions provoke 'puzzlement,' and/or where 'thinking' is required to produce an appropriate response, then learning will occur" (p. 10). Obviously puzzled, Kate said, "Maybe it's just a streak of luck....Maybe it's the bait. Well, let's just see what this does." As she knew she was fishing with people who cared about her and were willing to share their techniques, she continued fishing, operating by trial and error, until she was at last successful. Although Kate was visibly frustrated, she remembered that Jill hadn't caught any fish at that point either, and to show her concern, Kate said, "Well, she may not have caught a fish, but she got to feed the seal."

Another incident in the fishing activity that was problematic for Kate was seeing the pliers break the hook in Mike's fish, leaving the sharp metal barb stuck in the perch's mouth. This event caused Kate to fret. "Will it kill him?" she asked concerned. She was feeling compassion for the tiny perch, whose plight aroused a personal response in her. McManus (1992) pointed out that exhibits likely to arouse a personal response, especially ideas related to ecology, are effective in engaging children in learning. Kate moved from this horrifying "Gee-whiz!" experience to an "Aha!" moment of insight and understanding when I reminded her of a recent school experiment where she had witnessed balls of steel wool rusting in salt water and eventually disintegrating. She seemed relieved.

As I reviewed the videotape and watched the fishing event, this time as an observer rather than as a participant, I was mindful of Lucas and McManus' (1986) comments regarding the use of video recorders in data collection. They argued that there is the risk of people changing their behaviour and, "playing to the gallery" (p. 345) and that this effect needs to be taken into account in any interpretation of the data. Kate was aware of her mother on the ramp filming the fishing activity with a video recorder. However, Kate perceived the camera's presence as a way to record important details for my study as I was her science teacher the previous year. "Maybe you want to get a shot of this," she asked her mother as she held her baited hook up for a close-up shot. "Something different. See the difference? See? That's what they did. Isn't that unusual the way they just took that all in a circle?"

Kate was puzzled about the way the perch had left the neat little hole in her bait. Previously, she had perceived fish as creatures that bit the whole bait and got hooked as a result. Falk, Koran, and Dierking (1986) argue that "it is extremely likely that cognitive learning will occur at any exhibit at which a visitor spends a significant amount of time engaged in appropriate behaviour for the exhibit" (p. 506). Kate was doggedly determined to continue to use the herring "steak" all afternoon if she had to until she had caught a fish with it as she thought she should. "I'm going to take that thing because I'm going to try it

again.” She remained engaged in the fishing activity and eventually learned that the perch were more interested in the mussel tissue that Mike was using to catch fish successfully. “I’m going to try some mussel because that’s what attracted most of them, and one got snagged.”

When Kate arrived at the float to fish, she didn’t know she would be faced with so many problems. She expected fishing to be fun and easy to do as she had heard many people say it is so. The kind of difficulties she had are examples of “discovered problems” (Csikszentmihalyi, 1987), problems that emerge from naturally occurring dilemmas, as Kate had to discover just what the problem is in catching the perch: discovering the perch’s preferred bait, learning that this bait preference is related to the size and structure of the perch’s mouth, and learning how to get the delicate bait on the hook securely. She had already perceived that the bait must be on the hook securely, as early in the fishing activity she commented that the herring was on her hook but “it’s not very secure.” The children collaborated to help Kate solve the rest of this perplexing problem, and she was intrinsically motivated to try different strategies to solve her dilemma. When she finally learned to use mussel tissue as bait rather than herring and to use the muscular foot of the mussel to bait her hook securely, she had found the two keys to solving her frustrating problem.

During the group interview, when I asked Kate what the perch were doing to her bait, she replied, “They were making a hole in it.” She was simply restating her experience. Similarly, when I asked her what kind of line she used, she replied, “It was black.” However, when I asked Kate what the fish were doing together to her bait, she gave a response that was more explanatory: “They were helping each other.” When I asked her, “How were your friends helpful?” Kate gave a response that restated her experience as well as gave an explanation: “With the lines, like if they got all tangled up, and getting the bait on.”

Carlisle’s (1985) study of children’s activity at a science center also focused on the teacher’s role in qualitative research. He suggests that as teachers,

We judge the quality of the experience as it is going on. We judge the degree of involvement of individual children, their sense of excitement or pleasure expressed as curiosity, and their application to the activities provided....We are both observers and participants....Students see us as resource persons to answer questions and solve problems and as individuals with whom to share experiences. We become part of the field experience and contribute to it (p. 27).

Kate perceived me as a resource person to answer questions as well as help her solve problems. She shared her puzzling experience with me as an individual as well as a teacher. "Isn't that unusual the way they just took that all in a circle?" I became part of her fishing experience, helping her get the fish hook out of her sleeve and listening to her talk about the fish's behaviour.

In reviewing the video tape and making the transcriptions I observed that most of Kate's interactions on the float were with me. These interactions reflected my role as a teacher as well as a participant observer in the study. I encouraged her to verbalize ("So, what are they doing?"), prompted her to explain ("I wonder why that would be?"), helped her find bait ("Let's see if we can find another one."), and I introduced new concepts ("Do you notice all the mussels on here? But take a look at the shoreline.").

Although Kate described the fish as "annoying" and talked about "snagging" fish and how the fish hook ripped through a fish's lip, Kate was horrified to see the fish hook break in the live fish's mouth. "So, the hook is still in him? Will it kill him?" In scrambling to respond to her concern in a way that would reassure her and the other children that the fish would survive and also helping them make the connection to their school experiences and learning, I was engaging in what Shapiro (1994) calls "sensitive listening" and what Davis (1995) describes as "enactivist listening":

The mode of teaching seems to be more a matter of flexible response to ever-changing circumstances than of unyielding progress toward imposed goals" (p. 6).

I was as surprised as the children were to see the fish hook break. My flexible response to Kate's concern and the "ever changing circumstances" of fishing was to prompt Kate and the other children to reflect on their past experiences: "Remember we did that steel wool experiment in school?" Davis's enactivist listening and Aoki's (1992) notion of

pedagogical watchfulness and thoughtfulness extend my role as a teacher in qualitative research such as the present case study to more than just a participant observer, to inclusion as a fellow fisher.

Kate's Levels Of Engagement In Learning

Kate participated in the fishing activity at each of Feher's (1990) four levels of engagement in learning: experiencing, exploring, explaining, and extending. Appendix E provides detailed tables that list the data gathered from observations, interviews, and video transcriptions. The data is categorized for Kate and the other two children under each of these four levels in the tables so that comparisons among the children (i.e.: what was universal; what was specific) can be easily made. Examples of the data generated for Kate's levels of engagement in the fishing activity are summarized below. The summaries, like the Fish Tale, present a "portrait" of Kate, a fledgling fisher.

Experience

The first level of the children's involvement in the fishing activity can be divided into two types of experiences: sensory and perceptual. Data gathered for this level provide evidence that children use their senses to interact with the physical environment. Kate's sensory experiences were mostly visual and tactile but she also had several olfactory, auditory, and kinesthetic experiences. She smelled the rotting odour of herring as the fish thawed quickly on the float deck under the heat of the summer sun. She also smelled the distinctive odour of mussel tissue on her fingers as she opened the shells and tried to attach this bait to her hooks. She heard the noisy roar of a float plane as it passed low overhead and the loud throb of an outboard motor on a passing boat. She heard the sea gulls' raucous cries as they circled overhead, and she heard the crunch of mussel shells breaking under her foot.

Kate's kinesthetic experiences included the sensation of riding the ocean's waves as the wakes from passing boats caused the float to bounce up and down. Her tactile experiences were numerous. She felt the sharp barbs of fish hooks as she attached bait to them, and she felt a hook catch on her shirt sleeve. She felt the hard shape of the mussel shells as she searched for a way to open them and the curved shape of the treble fish hooks on the salmon hook-up leader. Through her finger tips she experienced the slimy texture of mussel tissue and the scaly texture of herring bait. Kate finally felt the persistent tug of a securely hooked fish at the end of her line. She felt the wet smoothness of the fishing line as well as the slippery streamlined shape of her "catch of the day."

Kate had many visual experiences. She saw a harbour seal swim underneath the float and sea gulls hovering over the float eyeing the thawing herring. She saw many perch feeding in the surface waters around the float, near the mussel-encrusted ropes dangling beneath the float, and near the shallow bottom of the sea. She watched several perch together nibbling the bait from her hook, especially taking the entrails from the center of the herring steak. Kate saw a variety of sea life on the ropes as I hauled them onto the float for inspection, and she watched the exposed hairy sea squirts squirting water when touched. She observed an abundance of mussels attached to the ropes and to the sides and bottom of the float and a noticeable lack of them along the shoreline. She watched several caught fish wriggling to be free of their hooks and saw pliers break a fish hook in a perch's mouth.

Several of Kate's experiences were perceptual. She experienced difficulty in getting the soft, slippery mussel tissue to stay on her hook without falling off. She experienced frustration in watching the perch nibbling at her bait but not grabbing the sharp hook. She experienced surprise when a fish hook caught in her sleeve and puzzlement at how she could get it out without ripping her shirt. She also experienced empathy when she saw pliers break a fish hook leaving the sharp barb in the fish's mouth.

Explore

Data gathered for this level indicate that children are motivated by intrinsic curiosity to investigate phenomena of interest. Kate explored different ways to open mussels and getting them to stay on her hooks. She explored fishing from different spots on the float and using two different colors and textures of fishing line. She “mooched” for fish by lowering her baited hook to different levels beneath the float and waiting for the fish to strike. She learned how to jig her line gently up and down to attract the fish to her bait. She explored different ways to get her line to go down, such as pulling out line from the rod tip and turning the reel handle.

Kate made several deliberate investigations in her explorations of the float phenomena. She experimented using herring and mussel tissue together as bait as well as singly in order to determine the effect on the perch she could see in the clear shallow water around the float.

Explain

In this level, data show evidence that children use verbal reasoning to explain phenomena. Kate explained to the other fishers on the float that the perch were smart as they were all there just nibbling at the bait and “wouldn’t get snagged on.” She explained that the perch were taking a chunk out of the center of her steak section, “the better part,” leaving a visible hole. She explained that the perch were going for the mussel rather than the herring bait, so that’s what she was going to use to catch her fish. She explained that if she put the mussel’s foot on the hook the tissue would stay on. She theorized that the perch were all helping each other, rather than fighting over the bait, so that they each got a little bit of it. She explained that “fishing does take patience,” as even though a fish may have been snagged, the hook can still rip through its lip thus freeing it. She explained that Mike’s perch was “the first catch of the day.”

Extend

In Feher's fourth level, data indicate that children generalize ideas and make connections to related phenomena. When Kate saw the pliers break the fish hook in a perch's mouth, she made connections to similar phenomena in her previous classroom science experiences. She had observed steel wool rusting in beakers of solutions and she realized that the metal hook would also rust away quickly in the salt water ocean. She generalized that fishing had a lot to do with luck, the black color of the fishing line that Mike had been successful with, or fishing from a certain spot on the float.

CHAPTER 6: JILL'S FISH TALE

Jill The Playful Fisher

The hot September sun was low in the sky when eight year old Jill hurried eagerly to the dock with her friends Kate and Mike. She chose a fishing rod and reel from the variety of mooching and spincasting equipment lying on the dock and then skipped down the ramp to the float. She lowered her line over the edge of the float and eagerly began to "fish" using a bare hook. Several wasps buzzed around her reel anticipating her catch. As she watched the activity of the shiner perch in the clear water around the float, she talked to the other children who were also getting their lines ready to fish. "Oh darn. A little fish was by mine too, you guys. A little one, a baby one. Oh, my rod's all twisted." She tried to untangle her line at the tip of the rod. "No, it's going. I got it. I pulled it up and there was a little baby fish. Just keep making it go down," she suggested to Kate beside her, "and he'll want it and grab it."

"He wants it but he can't bite it," replied Kate, also "fishing" with a bare hook.

"That's because we have no bait," explained Jill. She continued to "fish" by trying to lower her line by turning the reel, but she was puzzled. "It keeps coming up when I'm reeling it down. See? It keeps coming up when I'm trying to reel it down."

"Well, what can we do?" I asked her as I hurried down the ramp with a bag of bait. She started to turn the reel the opposite way and was successful.

As Jill saw me opening up a bag of frozen herring she called, "Can I put some bait on? Can I have a piece? I'm having the tail," she announced as she took the fishing knife and proceeded to cut the a large frozen herring in half.

Jill's attention was distracted by the children's excitement at seeing a seal swimming close to the float. "I want to feed the seal. Can I throw this?" she asked, holding up the head of the herring she had cut. "André! He's André." I learned later that this was the name given to a seal in a recent movie. "Where's the seal? That piece is mine

for the seal. I'm going to keep it right there." She pointed to the head of the herring that she placed on the edge of the float. The children enjoyed the effect of a boat's wake on the float, and, as it creaked noisily up and down, Jill commented, "Whoa! André must be having fun! Oh, the fish is going to fall off it!" She remembered the herring tail perched precariously on the edge of the float.

She looked around and something caught her eye. "Hey! I know what I can do! I see something I can catch." She took her rod to the other side of the float and proceeded to use it like a rake to try and reach a piece of floating bull kelp. While she was busy, the seal made another appearance by swimming underneath the float. "I missed him!" wailed Jill. "He stole my bait. I know it. He stole my bait!" She and Mike agreed to switch rods. Jill cut more herring and announced, "I have two pieces on."

"Ok, she's trying with two pieces now on her hook," I commented laughing. "So look at that. So, you've got two tails on. Is that better than two heads? Ha, ha! Ok, so we've got two tails on a buzz-bomb lure and Kate you've got herring on a hook. So, who's going to catch the first fish?"

Later, seeing the other children opening mussels to use as bait, she put her long rod down on the wooden deck of the float and tried to open a mussel. "I'm going to get one out." And then, feeling the slimy mussel tissue on her fingers, she changed her mind and said, "Ooooh, you can do this. I don't want to touch it." I showed her how to open and hook the mussel, but her thoughts were on the seal as she scanned the water around the float. "When is André going to come?"

Jill returned to fishing and became excited at the school of shiner perch crowding her bait. "Whoa! Look at how much fish are on mine! Look! Look at how much fish is on mine!" Her excitement caused the other children to reel in their lines quickly and then lower them near hers. "How come everybody's fishing over here?" she grumbled.

Jill's attention was distracted when she saw wasps buzzing around her, attracted to the smell of herring and crushed mussels on the float. "I like bees. Come on." One

landed on her finger. "I'm holding a bee again! Yeah, I was. Come here. Come here. See? See? Ouch! He wants meat. I have no meat. Stupid bee! Hey you! Stop it! I have no meeeeat!" Then she spied a large hand net on the float. "Can I use this net? I'm going to put some seaweed on my hook. André went somewhere else 'cause he didn't get my fishies." She continued swatting at the wasps buzzing angrily about her, "Oh, bee!" until one wasp stung her finger. "OW!" I suggested that she dunk her hand in the bucket of cold sea water on the float to relieve the pain.

When Jill saw Kate opening mussels to use as bait, she decided to do the same. "I'm going to get it open. With a spoon?" She spied the spoon on the end of the fishing knife. However, she changed her mind and began to cut herring, announcing "I'm gonna catch a fish for sure today." The wasps continued to buzz persistently around her. "If I swat him with the spoon will he die?" she asked.

"Well, do you really want to play with the wasps, or do you want to fish?" I asked, hoping to guide her to ignore the wasps so that she wouldn't get stung again.

"I want to fish" she replied. "But this won't crack," she said as she tried to open a mussel. She returned to her rod that she had left lying on the float, pulled up her line, and checked her bait. "The fish stole my bait! He stole my big one!"

"Jill wants to have mussels on here as well," I said to the parent with the video camera. Turning back to Jill I asked, "Do you want to do it?"

"No," she replied and watched me as I baited her large treble hook with mussels along with the herring she already had on it.

"Ok, so now you've got two kinds of bait on there. What do you think you will catch with two kinds?" I asked, wondering if she would explain why she decided to use both kinds of bait.

"I don't know," replied Jill.

"Let's try and find out. Have you got a picture of that?" I asked the parent who was video taping the activity. "Jill has two kinds of bait on here."

“Or else I could use two lines,” added Jill. She tried to maneuver the nine foot casting rod over to the edge of the float without bumping the other children engaged in fishing. “This is a big rod.” She realized that she couldn’t see the fish activity in the water from where she was holding the rod handle so she decided to solve this problem by asking me to hold her rod. “Can you hold this just for a minute so that I can see my bait?” She got down on her hands and knees and peered over the edge of the float. She brought up her fishing line by hand from the end of the rod and inspected her bare buzz-bomb lure. “Oh no! They stole it! Those bad fishies!” she declared grinning.

“So, now what are you going to do?” I asked, wondering what she would playfully experiment with next.

“I’m going to get some more,” she replied, heading for the bag of thawing herring.

“They stole it? So, do you think those fish are smart enough to steal things?” I queried.

Engrossed in thinking of a new strategy, she planned aloud. “I’m going to use the head. No, I’m going to use two pieces. The head... actually three. I’ll have the head, the tail, and the middle on the three hooks.”

“On the same line here?” I wondered aloud.

“Yep,” she replied inspecting the herring closely.

“Ok, let’s see how you’re going to do that.”

“See look? I have three. I have three hooks,” she explained, showing me the large treble hook on the buzz-bomb lure.

“You have three hooks,” I acknowledged. “So what are you going to do with three hooks?”

“Head, middle, tail. I’m gonna see if that’ll work.” She inspected the two fishing knives carefully and chose one. “I think this will cut more fish,” she said as she cut a thawing herring into three pieces. “Now what will happen?” she grinned.

“So, what’s going to happen if you put all three pieces on?” I asked.

"I don't know. Ask the fishies. I bet you the fishies know what's going to happen," she assured me. "This is gonna be really tasty, I know, so they can chew as much as they want."

"I'm interested in what you're doing here. You've got three pieces of herring and you've got three hooks," I continued, hoping she would explain her rationale for using this strategy.

"I'm going to fish," she announced happily as she attached two pieces of herring on the barbed hook.

"Even the wasps are interested," I said, laughing aloud.

"Where's my third one?" she said puzzled by why she couldn't see the third barb on the treble hook. "Oh, this hook has two. That's why I can't find it. This looks good." She took her long rod to the edge of the float and announced, "I'm going to cast. It looks like I could cast here."

"You're going to cast?" I quickly asked, concerned about her skills at casting in such a confined area with other children crowding her space. "You know what? If you try to cast your bait will all fall off."

"I'm not going to cast, I'm just doing to let it fall down," she assured me, motioning with her hand over the edge of the float. I realized that she had constructed a different meaning for the word "cast" than the meaning Mike or I had constructed. Since she had heard Mike use the term earlier "to fish," she had adopted the word too for her meaning of "to fish." Something else caught her eye in the water. "Wow, a big starfish. There's a starfish."

Meanwhile, Mike had caught a perch. "How are we going to get that hook out of there?" I asked.

"I'll show you," Jill quickly volunteered. "I see some pliers. We can keep him in a fish tank. We can put salt water in a fish tank. Mike, we can put salt water in our fish tank and keep him there. But he'll die in this water," she moaned. "Can I hold him? Can I

hold him before he goes back?" After Mike gently released his catch, she resumed fishing only to notice that "Hey! One of my other ones is gone! I'm gonna fish over here," she decided as she moved to the other side of the float and put her rod down on the deck again. "Now I'm going to leave it here and let another fishy get it."

"I wouldn't Jill," warned Mike.

"Yeah, I'm going to let the fishy take my bait," she explained. She saw the children examining the sea life on one of the encrusted ropes that I hauled up onto the deck, and she spied a sea star. "I'm going to cast with the starfish! No, nothing will bite it. I got it!" she cried as she plucked it from the ropes. "I'm going to cast with this," she announced as she showed the video camera the small purple sea star cradled in her hand.

"So, you're going to cast with this?" I asked. "So you think something will eat this? Do you think it would be tasty for something in the ocean?"

"Maybe the seal," Jill answered. "I hope something would eat it. What should I do with this tail?" she said pointing to the herring on her baited hook. "Can I step on that bee? I bet it'll die. Can I? Can I step on that bee? It's down." She is soon distracted from the wasps when Mike catches another fish. "Can I let it go this time?" she pleaded. She watched me using the pliers to remove the hook which broke as I twisted it. The three children expressed concern over the hook remaining in the fish's mouth. This time Mike handed Jill the wriggling perch but she dropped it to the float deck. After releasing the fish, she resumed fishing. "I'm gonna cast over that way."

"Cast?" Mike asked with an anxious frown.

"You're just going to mooch," I quickly explained, realizing her intent this time was just to lower her line into the water and wait for a fish to bite.

Jill picked up a small fishing rod and had the same problem turning the mooching reel. "Whenever I let this down, see? It comes back up." As she worked with the reel and line, Mike caught another fish. When I reached for the pliers again, she wailed, "Oh, it's going to get stuck in him though! It's going to get stuck." But this time the pliers worked

as intended and Mike released the fish without any remaining hooks or barbs. Jill resumed fishing but she still had not solved her reel problem. "Somebody help me let this down."

"Here," Mike offered, "I'll show you." He proceeded to pull out line from the reel rather than use the reel handle to turn it down.

"Can you tell me when it yanks?" she asked.

"You'll feel it," I replied.

"Is André here yet?" she wondered, gazing at the still water around the float. After seeing Mike catch three fish by using mussels as bait, she decided to open a mussel. "Can you help me get this off? Is André over there?" She resumed fishing, but noticed her bare hook: "Somebody stole my bait!" I helped her load up her hook again with mussel tissue and she finally caught a striped sea perch. "I got one!" she grinned proudly. Mike helped her unhook the fish and she released it over the edge of the float. Then she headed up the ramp with her friends, knowing that one of her playful fishing strategies had been successful after all in catching a fish.

Researcher's Interpretive Commentary

Jill arrived at the fishing site with happy anticipation as she had been looking forward to a fun-filled day with her friends. She was eager to begin "fishing," even before the frozen herring bait was out of its bag. She was intrigued with the novelty of the float site and attracted to the variety of fishing equipment lying on the dock. However, she perceived fishing to be more of an opportunity to "mess about" with playful exploration (Feher, 1990) of the equipment and resources available to her than in the actual task of catching fish.

Bateson (1994) believes that "the best learners are children...zestfully busy exploring...conjuring up possible and impossible worlds of imagination" (p. 73). As a novice to fishing, Jill used her imagination as a guide in using some of the equipment in

unusual ways. She viewed hooks as something to put bait on so that fish would bite them, and the more bait offered, she reasoned, the more the fish would be interested. So she decided to put three pieces of herring bait on the buzz-bomb lure's treble hook, even though adding bait defeats the lure's unique "wounded fish" action design. Lucas and McManus (1986) suggest that we should be alert to unintended exploratory behaviour, which may be as "scientific" as the planned possibilities.

Jill was confident in using her unique fishing strategies as she had visible proof that the fish were very interested in stealing her bait. At first she used one piece of herring, then two herring tails, and then she "scientifically" experimented using the head, middle, and tail sections of a whole herring. Even when she got stung by an angry wasp, she continued to "fish" by inventing new ways to use the equipment in her games with the "fishies."

Jill also used her imagination in her conversations with the other participants and in her "spontaneous unsolicited broadcasting of commentaries" (McManus, 1992). She constructed a story-line about the seal, which she characterized as André, that came to visit the site. Stories are a way of making sense to her (Wells, 1986), of giving meaning to observable events by making connections between them, such as when the seal swam underneath the float and then disappeared. She was constructing meaning and communicating to others about the seal using stories. "I'm leaving that herring for André...André must be having fun!" she cried as a boat's wake caused the float to creak noisily up and down. Later she announced, "André went away because he didn't get any of my fishies."

She also created stories as a way to tell about her understanding of the perch's behaviour beneath the float. Several times she deliberately left her rod lying on the float deck with the baited hook dangling over the edge into the water below so that the fish could dart out from under the float and take her bait. "Now, I'm going to leave it here and let another fishy get it," she explained with a grin. She perceived fishing as a new kind of tag

game where the object of the game was for the fish to steal her bait when she wasn't looking. Anticipating the perch's behaviour, she peeked over the edge of the float, brought in her line by hand, and cheerfully announced, "Oh, no! They stole it! Those bad fishies!"

Feher (1990) suggested that the interactive aspects of a successful exhibit is achieved by answering What if? questions. In the social context of this fishing vignette, Jill was interacting with the fish, the other children, the equipment, and with me. She was asking What if? questions to herself as she put the herring bait on the treble hook. "Now what will happen?" she asked me grinning, but already anticipating the result. "I bet you the fishies know what's going to happen!"

Jill's Fish Tale captures her easily distractible nature as well as her spontaneous inventiveness. Like the wasps buzzing about her, she darted from one spot on the float to another, engaging in impromptu fishing strategies. She perceived fishing to be a playful and active adventure, unlike Kate's view of fishing as a puzzling and frustrating activity that required patience. She also viewed the fish as playmates and showed no evidence of squeamishness in handling live fish or frozen herring bait (and eventually, fresh mussel tissue).

The novelty of the float site and the intriguing possibilities the fishing equipment offered Jill are features of successful interactive exhibits. According to Feher's (1990) findings, these features were effective not only in attracting Jill's attention as soon as she arrived at the float but also in holding her attention, and at times surprising her, during the entire fishing event.

During the group interview, I commented to Jill, "You had a problem there, didn't you, trying to get your line to go down?" I was hoping that she would verbalize how she viewed the problem and perhaps offer an explanation of why she had difficulty with the fishing reel and line. However, she simply responded by recalling her experience. "But it kept coming up." When I asked, "So, Jill, what would you put on your fishing line to make it interesting for fish?" I thought that the cue word "interesting" would prompt Jill

into giving an explanation. Again, she simply restated experience: "Bait." When I asked her if one part of the float was better than another to fish from, she replied, "By the shade," but she didn't explain why she thought so, even when I followed her response with three prompts: "Do you think that makes a difference? You think it's shadier on one side than the other? Do you think the fish would rather be in the shade or in the sun?" In comparing these interactions to our interactions during the fishing event, I noticed that Jill was more vocal while fishing and gave more explanations: "That's because we have no bait." "So they can chew as much as they want." "This hook has two, that's why I can't find it." In reflecting on this difference, I felt that the fishing event was significant in that it gave Jill a context to make storied explanations that were plausible to her. The group interview session did not provide Jill with a context for interpreting her experiences, only opportunities for simple recall and restatement of experiences.

In reviewing my interactions with Jill and reflecting on my role as a teacher as well as a participant observer in the study, I found examples of what Davis (1995) would call "naive listening: listening *for* something in particular rather than listening *to* the speaker" (p. 2). For example, I asked Jill, "Do you really want to play with the wasps or do you want to fish?" I was looking for the answer that she gave: "I want to fish." However, as I was curious about her strategies for catching fish using bait and the buzz-bomb lure in unorthodox ways, I asked her questions hoping to get explanations: "So, what's going to happen if you put all three pieces on?" Davis describes this kind of interaction as an example of "constructivist listening":

Questions posed in the vignette were information-seeking (as opposed to response-seeking), requiring some sort of demonstration and/or explanation. In other words, these were questions whose answers could not be fully anticipated by me (p. 4).

Jill's Levels Of Engagement In Learning

Like Kate, Jill also participated in the fishing activity at each of Feher's (1990) levels of engagement in learning: experiencing, exploring, explaining, and extending. (See Appendix E1 to E4.) The following summaries present a "portrait" of Jill, the playful fisher.

Experience

Many of Jill's sensory experiences were similar to those experienced by Kate. She also smelled the herring and mussel odour on her fingers and heard the crunch of mussel shells being crushed beneath the children's feet. She heard the noisy sea gulls overhead, the creak of the float hinge, and the motors of a float plane and passing boats. Like the other children, her tactile experiences included feeling the smooth hard shape of mussel shells and the soft texture of mussel tissue. She felt the sharp barbs of fish hooks and the slippery bodies of living fish. She felt the tug of a hooked fish on the end of her line. Jill also felt the painful sting of a wasp.

Jill shared similar visual experiences with the other children. She saw the seal and the perch beneath the float and the mussels covering ropes I had hauled out of the water and onto the float deck. She saw a small sea star on the ropes and laughed at the squirting action of the hairy sea squirts. She noticed the abundance of mussels on the ropes and watched hooked fish wriggling on the deck. She saw pliers break a fish hook in a perch's mouth.

Jill also had perceptual experiences while fishing with her friends. She experienced difficulty getting the mussel tissue to stay on the fish hooks, difficulty in seeing over the edge of the float while using the nine foot long rod, and frustration in getting the line on her reel to go down. She experienced surprise at seeing a seal swimming beneath the float and surprise when her bait was taken by the perch. She experienced empathy for the perch released alive but with a broken hook still in its mouth.

Explore

Jill explored different ways to get her fishing line to go down, different ways to open mussels, and different ways to attach herring to her hooks. She explored the encrusted ropes looking for different creatures to use as bait. She experimented by fishing with a sea star, seaweed, herring, mussels, and herring and mussels together on a hook. She cut a frozen herring into three pieces, one for each barb on the buzz-bomb lure's large treble hook. She explored different ways to "mooch" for fish from the float, even leaving her rod lying on the deck with the baited line dangling in the water, and then checking her hook by pulling in her line like a hand line. She tried using her fishing rod as a rake to attempt to catch a piece of floating seaweed.

Explain

Jill explained that the fish wouldn't bite the bare hook "because we have no bait." She put a piece of frozen herring on the edge of the float "to feed André the seal," and then she explained that he went away because "he didn't get any of the fishies." She explained that "the fishies know what's going to happen" when she lowered her baited hook. She explained that she couldn't find the third barb on the large treble hook because one section of herring bait had two barbs stuck in it.

Extend

Jill extended her conceptual knowledge of fish odours when she said, "I smell like salmon." She made a connection to the physical needs of fish when she suggested, "We can put salt water in our fish tank and keep him there." She linked the task of removing a fish hook from the perch with the use of an appropriate tool such as pliers. Since she enjoyed the bouncing ride on the float she decided that André the seal "must be having fun" too.

CHAPTER 7: MIKE'S FISH TALE

Mike The Experienced Fisher

When ten year old Mike arrived at the dock, he spied the nine foot long fishing rod with a spin casting reel. On the end of the line was a buzz-bomb lure with a large treble hook. He began to cast with the rod and watched as his air-born lure sailed through the air and splashed into the water some distance away from the float. As he reeled in his lure with a series of reel turns and rod pulls, he watched the girls "mooching" with bare hooks on a line dropped over the edge of the float. "Is there any bait?" he asked. Squinting in the hot afternoon sun, he looked out over the still water at a noisy boat passing by. "Man, I'd love to be fishing off that boat right now," he said as he cast his line out again. When I opened the bag of frozen herring, he explained to Jill, "It's supposed to be frozen."

"Do you think you could catch a fish with that?" I asked him holding up a large frozen herring. "Or is it too big?"

"You'll have to cut off a little bit," he advised. "Unless we're fishing for a huge fish!" he added, grinning. He began to cut the frozen herring in half. "It's hard." He helped Kate get her herring bait on her hook. "I'll use this little piece. They'll just be nibbling. Here, that'll work for now," he said as he handed her the baited hook. He paused to watch a seal make its appearance near the float. "We'll probably get the seal!"

As I watched Mike put the large herring on Kate's small single-barbed hook, I decided to show him other hooks he could use. "Have you used these kind of hooks before, Mike? These are called herring hook-ups. There's a loop on the end, see? Maybe you can put it on this one." I unwound a herring hook-up leader (also called a salmon hook-up) from the rectangle of foam holding it.

Mike inspected the two barbed treble hooks on the leader very closely. "Yeah," he announced. "These'll do better."

"It's like a safety pin, isn't it?" I said as I showed him the end to fasten the hook-up to the fishing line. "Then you can change your line real easy."

He rehooked Kate's herring more securely on the herring hook-up and then put a herring head on the end of his buzz-bomb lure. "I just don't want to hook the seal," he said, as he looked about the surface of the water and resumed casting.

"Wow! You've been practicing!" I commented on Mike's good casts. "What do you think you might catch now, out there?"

"I don't know," he shrugged, as he made his buzz-bomb lure wiggle through the water towards him like a wounded fish.

"Well, what do you think could be out there, besides the seal?"

"Um. I don't know." He continued to cast and soon saw the tip of his rod bend over as he reeled in his line. "I got one, but it...I don't know, maybe the bottom."

"How are you going to get it off?" I asked, wondering if he had a plan to get his hook unstuck. As he seemed uncertain, I showed him a strategy and brought in his line complete with attached seaweed pulled from the bottom.

"My bait?" he asked looking at the seaweed covered hook.

"You might have lost it on the seaweed bottom," I replied, untangling the hook.

"Where is the bait? In the bag?" he asked. "Ah, here's a small piece." As he cut the herring, he listened to Kate's problem about the fish taking her bait but not getting hooked. He advised, "You've got to get deeper. You've got to get deeper, then you can catch them."

"So do you think the fish are fighting with each other, or are they helping each other?" I asked the group of children.

"Maybe...I don't know, maybe they're fighting," suggested Kate.

"Or helping, because...", Mike said thoughtfully. He continued to cast with the long rod and then decided to use a smaller mooching rod. "If someone wants to use mine, my rod." Jill was eager to trade rods with him.

"Have you ever tried to use mussels as bait?" I asked, hauling up one of the dangling mussel-encrusted ropes onto the deck of the float.

"Yeah," replied Mike.

"Does that work?" I asked, plucking a few large mussels from the rope.

"Yeah," he answered.

"How do you open it?" I asked, handing him a mussel.

"Sometimes you can just step on them," he said demonstrating with his foot.

"Ok. Now what are you going to do?"

"Open it. Oh, it's still alive!" he cried as he began to pick gingerly to remove the bits of broken shell.

"How do you get it out of there?" I wondered aloud, watching him dissect the mussel.

"Just scrape it out."

"Is there a certain part of the mussel that's really good for hooking?" I asked.

"Some people say the worm is. But you have to hook it. That little worm thing," he said pointing to the mantle of the mussel which was lying like a dark wavy ribbon along the edge of the shell.

"That little worm thing? It looks like a worm, doesn't it, the edge? Ok, show me how you do it," I said bringing the old mooching rod closer to him.

"What is that? Is it like, string?" he asked, noticing the old black cord fishing line in the old rod and reel and feeling it with his fingers curiously.

"It's a black cord. Yeah, it's a really old one. But it works well. It's a different color than the other line. Do you think that might be a good idea or not?" I queried.

"I don't know. Not really," he decided, "'cause they might see it."

"You're the first person that's noticed the color of the line," I told him. "So, you think the fish might see it?"

"Yeah."

"And if they see it, then what?"

"And then they'll think it's something weird," he explained.

"They'll think it's a trap?"

"Yeah."

"Ha, ha. That could be."

Mike resumed the task of removing the mussel flesh from the crushed shells and baiting his hook on the rod with the black fishing line. "You're supposed to try and snag them," he advised Kate as she described her continued frustration at watching the shiners nibbling her bait away. When I asked him what corner of the dock he wanted to fish from, he replied pointing, "This one because there are lots of little fish there."

"What do you think, Mike? We have all these mussels here on this rope, and there's another rope here full of mussels, but there's none over there," I said pointing to the shoreline.

"Maybe because it's deeper here," he suggested, lowering his line into the water.

"You think it's deeper here? Those ropes..?" I asked pointing to the mussel-encrusted ropes floating on the surface of the water and holding the float to the shore.

"No, those ropes have seaweed on them," he explained.

"What about these ropes here," I asked, pointing to the encrusted ropes I had hauled up onto the float deck. "It's a puzzle isn't it? I wonder. Do you remember what we talked about in school about predators? What eats mussels?"

"Oh yeah, predators don't come this shallow," he explained confidently. At that moment a wasp stung Jill and, hearing her loud "OW!" Mike shifted his attention from fishing and my questions to one of concern: "Did it sting you?" He soon resumed fishing again and when I asked him if he still had enough bait on his line he replied, "I've got a bunch of them over here. I don't know. I haven't checked. I'll check it." Seeing his bait gone, he said, "I'll try to snag 'em." He baited his hook again with mussels and resumed fishing. "Oh, look at that big one! There's big ones over here! Oh, I felt a tug. You guys, I got one! I got one! Oh, it went away."

"What were you using as bait?" I asked.

"A big gob of... Yeah, but I got one!" he announced excitedly. "This is one of the best fishing spots!"

"What will you do to make sure that the fish stays on? What strategy could you use?" I asked.

"I felt the rod and then..." But he was more intent on searching for another large mussel on the ropes. When he found one he turned to me to ask, "Could you help me hook it on, because the way you hooked it on..."

"Ok, I'll show you. Now with this piece here," I said pointing to one of the shells, "I just take my thumbnail and scrape it off just like that and get it clean. It's really hard on your fingernails. Now we have to find the tough part. Oh, there it is."

"Yeah, but how do you like, get it on so it's..." he asked puzzled, intently watching me baiting his hook and keen to know my technique.

"You have to get it right through the middle of that part," I said pointing to the mussel's muscular foot. "Hang on a second Jill," I hollered to her over my shoulder. "We're just hooking a nice fat mussel here." Then I turned to Mike and continued the task in my hand. "Ok, now wrap the rest around it so that the hook is hiding."

Mike resumed fishing and quickly announced "Hey! I got one!" He reeled in a striped sea perch. "It's a rainbow, I think," he stated proudly showing his catch.

"No, this is a striped sea perch. Yeah, it looks like rainbow colors doesn't it? So what kind of bait were you using Mike?" I asked.

"Mussels," he replied.

"Mussels? So, do you think mussels work better than herring?" I queried.

"Kinda. Well, it depends on what you're fishing for," he answered.

"What's your secret in catching this one? I asked him. "What did you have to do to get it on your line?"

"I just dropped it down."

"You just dropped it down. And then what did you do?" I probed.

"Usually I just reeled it up," he replied. "Are those like spikes?" he asked curiously pointing to the perch's dorsal spines as it lay on the deck.

"Yes, those are spines. Now, how are you going to get that off there?" I asked, pointing to the hook. He tried to get the hook out with his fingers but the fish wriggled too much. "Do you want some help?" I offered. I showed him how I use the pliers to twist the hook out, but this time the hook broke as I twisted it. The children gasped in horror.

"Did you break it?" Mike asked in a concerned tone, and he leaned to get a closer look at the barb stuck in the perch's mouth. I explained that the hook will rust out soon and that the fish would be ok.

"Take a look at the size of the mouth on this fish," I suggested. "Do you think it could actually catch herring?"

"Nope," replied Mike, "'cause its mouth is too small." When I asked the children what the perch might eat, they all agreed "mussels!" Mike released his fish, relieved to announce that "Yeah, he's still alive. And I caught it with the black line too!"

"Oh, isn't that interesting. Now what kind of theory do you have?" I asked him.

"So...maybe both of them work," he decided.

"So, maybe both kinds of lines work?" I echoed.

"Yeah."

"So, maybe you think the fish couldn't see your line because it was black?"

"Um, yeah, maybe. Or maybe because, um, the hook part was dark," he added. Mike hauled up another encrusted rope and began to explore it for large mussels. "Oh look!" he called to the others pointing to hairy sea squirts on the rope. "It just squirted all by itself! They're alive! It looks like a...with hair. They look like strawberries. Ha ha."

"We'll have to remember that description when we look them up. Now, what do you think the perch might be eating on this rope?" I asked.

"Maybe some of the stuff," he suggested pointing to the rope. He baited his line again and quickly caught a shiner perch.

"He caught another fish! It must be the black line!" Kate decided.

"Yeah, that's a shiner," he announced proudly as he began to remove the hook.

"Oh, this one's easier. I'll hold the jaws. Here, Jill, do you want to let him go? Hurry!" He handed her the fish to release and then exchanged rods with Kate. He baited the hook on a clear fishing line and resumed fishing. "I got one!" he announced for the third time as he brought in a pile perch.

"What? Again?" complained Kate, who was using the rod with the black line.

"I hooked him in two spots. I just don't want him to wiggle." He used the pliers carefully to remove the herring hook-up from the perch. "I got him in two spots."

"We've got three fish caught by the same person," complained Kate.

"But this rod you were using didn't have a black line on it," I commented.

"Yeah, so it's not the black line," he agreed thoughtfully.

"Maybe it's just a streak of luck," Kate suggested resignedly.

"Maybe it's just luck," he echoed. "Maybe it's just where I dropped it."

"So, you saw all the tiny shiner perch. They looked like they were fighting over it? What did you decide they were doing?" I asked.

"Maybe they were helping each other," Mike suggested.

"Maybe they were helping each other," I repeated thoughtfully.

"Yeah, they were all taking little bites out of it," he decided.

"Maybe I'll try Mike's spot," Kate announced. "I never caught any."

"Yeah, maybe it's the spot, ha, ha!" Mike chuckled and he began to help Kate by giving her advice, rather than continuing to fish himself. "You have to jig it up and down. That's how I caught them. Sometimes I just snag it up," he said motioning with his arms.

"I wonder why the fish go for it when you jig it up and down?" I asked.

"So they think it's alive," he replied.

"Oh, so they think it's alive," I echoed thoughtfully. "I see. That's a good strategy. So, you think fish would rather go for stuff that looks like it's alive than just sitting there?"

"Yeah, 'cause like...not really. Are you reeling it up?" he asked, turning to Kate. When I announced that I have more mussel ready to use as bait, Mike answered, "Kate can have it." She baited her hook and he continued to give advice over her shoulder. "Oh, there's a big one right there. Catch it, Kate! There's lots of them. Pull it up! No, down a bit more!" A boat's wake caused the float to bounce up and down, and Kate's line on her reel got tangled. Mike tried to help her pull it out. "It's fixed." She dropped her line in the water again and Mike watched the fish near her baited hook intently. "Whoa, whoa! Stay there, stay there! Actually, reel it up a bit. Reel up, reel up! There's a big one right there! Go over there some more. There! Stay there! Yeah, you got it!" he announced as Kate reeled in a fish at last.

"I got it! I got something!" she beamed proudly.

"Yeah, you got it. You just snagged it," Mike pointed out. "That's a three... a shiner. I was going to say a shiner! Ha, ha!" He continued to advise Kate as she resumed fishing. "They're huge! The big fish are under the dock. Look! The big fish are under the dock."

"Under the dock?" I echoed. "Well, why would they want to be there?"

"Maybe there's like, food at the top of the dock," he suggested. "Could be mussels or something."

"What about predators?" I probed. "Could there be predators there?"

"No," he replied. "Probably not." As Jill caught her first fish, Mike tried to recall it's name. "Oh, yeah, a striped..." Then he noticed part of its entrails protruding from its vent. "Oh, it looks like its going to have babies or something!"

"Do you know that all these perch give birth to live babies?" I explained, as Jill released her fish. The children watched it swim away and then began to gather up the fishing equipment. As the sun was setting on their fishing activity, I headed up the ramp with the children knowing that each child had had a successful "catch of the day."

Researcher's Interpretive Commentary

Mike quickly picked out the longest fishing rod to use when he arrived at the dock for an afternoon of fishing with his friends. The nine foot long rod had an open-faced spinning reel, and he gripped it like he knew how to use it. Mike began to cast his line from the float using one hand deftly to grasp the fishing rod and the other hand to flip the reel bar. He obviously had had practice in casting his line quite a distance out from where he stood, perhaps using similar equipment. Mike knew how to make the buzz-bomb lure move through the water towards him like a "wounded fish." However, he also decided to use it in a manner that was not as the designers of the buzz-bomb lure had intended, by adding a small piece of herring to the lure's large treble hook to test its effect. After several good casts and getting his hook stuck on the seaweed bottom once, he decided it was time to try a different fishing strategy. He changed rods with Jill, baited the single hook with tissue from crushed mussels, and dropped his line over the edge of the float. He began to mooch for fish by lowering his baited hook near a school of perch and sometimes gently jigging his line up and down. He watched the effect intently. These activities gave him opportunities to practice using different fishing skills.

Mike perceived his role on the float to be a helpful one as he baited Kate's hook with her herring "steak" and helped her to be successful at finally catching a fish. He gave her advice on where to drop her line, how to snag the fish, how deep to put her hook in the water, and when to pull her line. He showed empathy for Jill when she was stung by a wasp, and he gave his lucky rod to others so that they could be successful at catching fish too. It is interesting to note that just as he was being helpful on the float, he perceived that the perch were also helping each other in the task of getting food off the baited hook.

Mike was the only child to notice the old black cord-like line on the old mooching rod and reel. All of the other rods had typical clear or blue monofilament fishing lines. He didn't think the dark color was a good idea to use as the fish would see it. He probably rationalized by thinking to himself, "If I can see it, surely the fish must see it too, and they

won't be fooled either." He concluded that "They'd think it's something weird." Driver's (1983) metaphor of the pupil as scientist explains that

"Looking at" is not a passive recording of an image like a photograph being produced by a camera, but it is an active process in which the observer is checking his perceptions against his expectations (p. 12).

Mike was actively looking at the black line, checking his perceptions against his expectations, that the color would affect the line's effectiveness in catching fish.

Feher (1990) stated that "People are explanatory creatures. They form theories, or mental models, to explain what they experience" (p. 37). The mental model that Mike had was that a visible black cord, which he had never seen used on a fishing rod before, was unlikely to be as effective at catching fish than the more familiar clear or transparent blue monofilament fishing lines. Feher believes that a spontaneous remark like "weird" carries a different message that she interprets to mean

It's puzzling. I expected something else....This effect is contradicting my previous experience, my previous beliefs, my prior conceptions; I must not understand what I thought I understood (p. 37).

Feher argues that by confronting visitors with their preconceived notions a "weird" exhibit opens the way for conceptual changes to occur. In this vignette, Mike was confronted with his preconceived notions about the effectiveness of clear fishing lines. Although he was skeptical of the black line's effectiveness in catching fish, Mike used it willingly and was immediately successful at catching fish twice in a row. He quickly attributed his success to the black line saying, "Maybe both of them work." Mike's explanation indicates that he was trying to save his original theory or model (that clear or blue transparent monofilament lines catch fish) by accommodating the new evidence (that the black braided cord line also catches fish). When he caught his third fish using a rod with a clear line, he was visibly puzzled. "So, it's not the black line," he finally decided.

The black line on the fishing reel was an example of an interactive exhibit that Feher (1990) would describe as successful in attracting and holding the child's attention and one that clearly had the ability to surprise the user. Mike then began to think of rational reasons

why he was successful and the other children hadn't been: "Maybe it's where I dropped it." It is interesting to note that he didn't perceive his success as due to his fishing skills, but as a result of some external factor such as type of bait and where he dropped his line.

Mike's conversation with the researcher is an example of what Schön (1983) would call "reflection-in-action," a spontaneous process of "reframing experience" as it proceeds. Whereas I am "reflecting-on-action," thinking back to this past interaction that occurred on the float, Mike was reflecting on his black line theory and obviously wrestling with what was to him a discrepant event: fish getting caught on a visible black fishing line. From Schön's (1983) point of view, Mike was "paying attention to phenomena and surfacing his intuitive understanding of them" (p. 72), and as a result he perceived these events as "situations of uncertainty, instability, uniqueness, and value conflict" (p. 50). Being puzzled and surprised prompted him to generate new ways of looking at what was occurring and to reframe the experience by exploring new hypotheses: "Maybe they both work." Through reflection on this discrepant event, Mike was constructing new meanings. Tuckey (1992) believes that an effective exhibit will provide an experience which interacts with the child's current concepts and hence create new understanding.

Mike was beginning to understand that there is more to fishing than meets the eye. It sometimes amounts to "thinking like a fish." When Mike told Kate to "jig the baited hook so that it looks like it's alive," he revealed his perception that fishing is an activity that requires a variety of skills and rational thinking in order to be successful. He perceived that attempting to see things from the fish's point of view would help him be successful in catching fish.

This narrative Fish Tale showed that Mike engaged in problem solving by drawing analogies with familiar everyday situations in order to make sense of new phenomena that he encountered. He was making personal connections to his previous experience when he said that the black fishing line "looked like string" to him, the edge of the mussel's mantle "looked like a worm," and the hairy sea squirts "looked like strawberries."

Mike was also making connections with his prior knowledge when he was confronted with the puzzling situation of mussels growing on dangling ropes but not along the shore. Feher's (1990) research examined the intuitive notions that children bring to novel situations and how these notions shape their interpretations of the phenomena which the children observe and manipulate. Mike noticed intuitively that the mussels on the encrusted ropes dangling beneath the float were in deeper water than the rocks along the shoreline, so he explained, "Because it's deeper here." However, his intuitive notion that mussels prefer deeper water than at the shoreline seems to contradict his interpretation of why predators couldn't reach the mussels on the ropes: "Because predators don't come this shallow."

McManus' study (1992) found heightened levels of verbal activity at interactive museum exhibits and she concluded that interactive exhibits encourage social interactions. As Mike's Fish Tale shows, there was a great deal of conversation among the children and myself while engaged in the interactive aspects of our fishing experience. It was apparent that Mike perceived fishing as a social experience where he could bond with peers and adults who have shared interests and care about each others' well-being. He did not spend time rushing about but was content to remain on the float patiently fishing, helping others, and talking about fishing.

McManus also noted that "Teaching occurs as a fundamental aspect of the spontaneous social interactions within the group" (p. 175). Mike demonstrated several spontaneous teaching behaviours while engaged in fishing with his friends: pointing to the creatures on the encrusted ropes, telling them to watch the sea squirts squirting water, telling Kate where to put her baited hook, advising her how to use her rod, describing the appearance of the mussel's mantle, and raising questions: "Could you help me hook it on, because the way you hooked it on...Yeah, but how do you like, get it on so it's...?" He frequently helped the two girls and offered them suggestions about improving their success in catching fish: "You have to jig it up and down. That's how I caught them."

Driver (1986) argues that from a constructivist perspective there are patterns in the types of meanings children construct due to shared experiences with the physical world and through natural language. As I reviewed the videotapes of each of the fishing events, I became a vicarious observer noticing patterns in the language shared by the children. Mike used the word "nibble" to describe how the small-mouthed perch would approach the baited hooks. "I'll use this little piece. They'll just be nibbling," he said. Later on, Kate assimilated the word into her description of the shiners' feeding behaviour: "They're just nibbling at it and they won't hold on." Rather than saying "hook the fish," Mike and Kate both used the expression "snag 'em" several times during their conversations. Mike had probably heard the word used many times at a local salmon hatchery where his grandfather works. He had probably also watched fishing enthusiasts, who gather on Sechelt Inlet every fall near the Sechelt Indian Band hatchery, using buzz-bomb lures to try and "snag" the returning salmon as they congregate in large numbers in McLean Bay. Using natural language, the children constructed a meaning for the way to catch fish as they were sharing the fishing experience on the float.

During the group interview, when I asked Mike what kind of bait he used to catch his fish, he gave a reply that restated his experience: "Mussels!" However when I asked, "Does it matter which corner of the dock you're on?" he gave an explanation: "No, not really, 'cause the food might attract them to that corner." Mike also gave an explanation when I asked the group, "So when would you use herring and when would you use mussels?" He explained, "I would use the mussels for what we were fishing for, and the herring for the bigger fish 'cause they have bigger mouths." Mike was two years older than Jill and had more fishing experience, which may account for why he was able to respond in a decontextualized setting to interview questions with more explanations in the same manner that he responded to my conversational questions while immersed in the context of fishing.

During the small group interview, after the children had seen their fishing video,

I mentioned to Mike that he caught two fish with the black line. He immediately “corrected” me by saying, “Three with the black line.” Since I had already previewed the videotape several times before watching it again with the children, I knew that he had traded his rod before catching his third fish. I rephrased my question, seeking clarification: “You caught two with the black line and one with the clear line?” He responded quite confidently, “No, I used the black line the whole time.” He had convinced himself of the black line’s effectiveness.

As I reviewed the videotapes and transcriptions, I reflected on my role as a teacher and as a participant observer in the study in my interactions with Mike. I found some examples of “naive listening” (Davis, 1995): “What do you think you might catch now, out there?” “What do you think could be out there besides the seal?” I anticipated a “fish” response. When I asked Mike, “What eats mussels?” I expected him to list some predators he is familiar with on the coast. I also found examples of “constructivist listening”: “How are you going to get it off?” I was seeking information about Mike’s plans to get his hook unstuck from the sea bottom. When I handed Mike a mussel, I asked him, “How do you open it? How do you get it out of there?” When Mike shifted his attention from baiting hooks with mussel tissue to noticing the black cord fishing line, I shifted my attention to “enactivist listening” and asked Mike, “Do you think that might be a good idea or not?” When he caught his third fish with a clear line, I asked him, “Now what kind of theory do you have?”

Mike’s Levels Of Engagement In Learning

Mike participated in the fishing activity at all four of Feher’s (1990) levels of engagement in learning: experiencing, exploring, explaining, and extending. (see Appendix E1 to E4.) The following summaries present a “portrait” of Mike as an experienced fisher.

Experience

Mike's sensory experiences included seeing the seal swimming under the float, watching the perch feeding in the shallow waters around the float, observing the perch nibbling away at the bait, and seeing pliers break a fish hook in the perch's mouth. He felt the tug of a hooked fish on his line three times, and he watched his catch wriggling on the deck. He heard the noise of float plane and boat engines and the sea gulls' cries. He felt the slimy texture of mussel tissue, the scales of herring bait, and the slippery bodies of his "catch of the day." He saw a variety of sea life on the encrusted ropes and watched the sea squirts squirting water. He observed the abundance of mussels on the ropes and the lack of visible mussels on the shoreline. He smelled the odour of thawing herring and mussel tissue on his hands.

His perceptual experiences included difficulty in getting the mussel tissue to stay on his fish hook. Like the two girls, Mike experienced empathy when he saw the pliers break the fish hook in the perch's mouth. He also experienced empathy when he saw Jill get stung by a wasp and when he sensed Kate's frustration at not catching a fish as easily as he had. Although he enjoyed using the long rod and spinning reel, Mike was concerned about the possibility of hooking the seal with the buzz-bomb lure when he cast it from the float.

Explore

Mike explored casting with the buzz-bomb lure from the confined space on the float. He experimented using the lure's treble hook bare and then with a section of herring bait. He fished with an old rod that had a black cord fishing line and with a rod that had a clear monofilament line in the reel. He explored opening mussels in different ways, scraping out the tissue, and finding the best part of the tissue to impale on the fish hooks. Mike explored "mooching" using different hooks, rods, line, and bait. He explored a strategy for getting his stuck hook off the seaweed bottom. He explored ways to use the pliers to remove fish hooks from caught fish.

Explain

Mike explained that the black fishing line wasn't a good idea to use "because the fish would see it and think it's something weird." He explained that he was going to fish where he saw lots of little ones and that the best kind of bait "depends on what you're fishing for." He explained that the mussels were in abundance on the ropes because "the water is deeper" than at the shore and because "predators don't come this shallow." He explained that the perch's mouth was too small to catch a herring and that the perch like to eat "the stuff on the ropes." Mike educated the others when he explained that Kate had to "go deeper then you'll catch them," and that "you have to snag 'em." He theorized that jigging the fishing line was a good fishing strategy because "then it looks like the fish is alive."

Extend

Mike used analogies to make connections to similar phenomena when he explored the float phenomena. He compared the hairy sea squirts to strawberries and the black fishing line to string. He called his blue and gold striped sea perch "a rainbow" and the perch's dorsal spines "spikes." He extended his conceptual knowledge when he saw the perch's entrails protruding from its ventral vent, and he decided this sight "looks like it was going to have babies." He theorized that the jigging action would attract fish because the bouncing bait or lure would cause the perch to think "it's alive."

CHAPTER 8: DISCUSSION

I mean to present my case so that it can be read with interest in the case itself, but I always have another agenda—to learn from the case about some class of things.

Peshkin (1986)

Introduction

“Catch of the Day” is a case study of children’s perceptions of their fishing experience that can be read, as Peshkin (1986) states, with interest in the case itself, and also to learn about the nature of children’s perceptions in an informal learning environment and the ways in which children share their experiences. Peshkin’s rationale and Stake’s (1994) epistemological question, “What can be learned from the single case?” provide a focus as well as a framework for discussing the findings of this naturalistic case study.

Stake emphasized that the intent of the case study is “to optimize understanding of the case rather than generalization beyond” (p. 236). Some aspects of this case study will generalize to other groups of children fishing off a marine float in another time and place, and some aspects of this study are unique to the particular group’s fishing event or to the particular child engaged in it. Erickson (1986) argues that the central task of case study analysis is

to uncover the different layers of universality and particularity that are confronted in the specific case at hand—what is broadly universal, what generalizes to other similar situations, and what is unique to the given instance (p. 131).

One of the key factors described by Stake for understanding cases is that “the case is a functioning specific....it is a bounded, unique, and integrated system....it has working parts; it probably is purposive” (p. 236). The present case study of children’s perceptions of fishing is clearly “a unique, bounded, purposive, and integrated system.” Within the physical confines of a small marine float, small groups of children gathered for the purpose of fishing in a social, recreational context. Each group of children shared experiences and

perceptions that were unique to their group as they collaborated together in solving their fishing problems and in assisting each other to have a successful “catch of the day.”

A second factor described by Stake (1994) as essential in understanding the case is that “its behaviour is patterned. Consistency and sequentialness are prominent” (p. 236). There was a universal pattern of behaviour among the groups of children fishing in the study that can be described as consistent and sequential. In their physical interactions and in their social interactions within the group, the children experienced baiting their hooks with different bait choices, struggled to get these to stay on, looked for other bait on the encrusted ropes, untangled fishing lines and reels, assisted others through showing, telling, and advising behaviours, checked their hooks periodically, and spontaneously broadcast commentaries as they fished and solved problems together as a social group. When the goal of catching a fish was reached, the children released their fish and started the procedure again.

Geertz (1973) argues that “it is not necessary to know everything in order to understand something” (p. 20). These Fish Tales do not tell the whole story of the children’s experiences for, as Stake (1994) points out, “the whole story exceeds anyone’s knowing, anyone’s telling” (p. 240). But readers of the study will experience the fishing event vicariously and gain insights into the nature of the children’s perceptions and learning in a social and recreational context, while at the same time appreciating the particularities of the case. The descriptive narratives—Fish Tales—can assist readers to make their own personal interpretations of the case.

Discussion Of Research Questions

This chapter discusses the findings of the three research questions that guided this qualitative study:

1. What did the children experience and explore?

2. How did the children share their experiences?

3. What were the children's perceptions of fishing?

In the discussion, the similarities and differences of the groups—what was universal, what was specific—are explored, in order to show how the experiences and perceptions of Kate, Mike, and Jill compare with those of the whole study group. The discussion also describes the increasing differentiation of Feher's (1990) four levels of engagement in learning observed in the groups and how this differentiation contributes to the uniqueness of perceptions among the children.

The chapter summary describes the "Catch of the Day's" strengths and how the case study supports and extends current research findings on informal learning. The findings suggest implications for teaching practice that could help to reduce the gap between in-school and out-of-school learning. The summary also gives suggestions for future research on children's perceptions and learning in the field of informal learning.

Question #1: What did the children experience and explore?

Many previous studies have focused on what children do in informal learning environments such as museums and science centers and how children interact with the social and physical environment in these settings. Geertz (1973) pointed out that

Studies do build on other studies, not in the sense that they take up where the others leave off, but in the sense that, better informed and better conceptualized, they plunge more deeply into the same things (p. 25).

By plunging more deeply into Feher's (1990) notion of levels of engagement in learning, the present study provided a categorized data base (See Appendix E.) that was used as a starting point for analyzing what the children experienced and explored while fishing and how the children shared these experiences with other participants. In addition, working with the notion of levels of engagement allowed new sub-categories to emerge from the data in the manner described by Glasser and Strauss (1967). Three additional levels of

engagement in learning are proposed in this study that can be added to Feher's (1990) list: experimenting, teaching, and empathizing.

Feher's category "exploring" suggests that the child discovers new features of phenomena through exhibit manipulations. As the children in the study explored the mussel-encrusted ropes hauled onto the float deck, they discovered that a variety of creatures besides mussels were attached to the ropes or adhered to the mussel shells. As the children observed the perch's behaviour around different kinds of baited hooks, they discovered that the perch preferred mussels over herring. The new category "experimenting" suggests that the child intentionally acts with a-priori plans to investigate and reveal other features of the phenomena through systematic manipulations. In the fishing event, Jill made a plan to cut a whole frozen herring into three pieces and attach these to the barbs of a large treble hook to test the perch's reaction.

"To teach is to learn" is a well known maxim, and the category "teaching" suggests that the child is at a level of engagement in learning that employs higher-level thinking skills of analysis, synthesis, and evaluation. Mike used thinking skills when he listened to Kate's complaints about the perch not getting snagged on her hook, when he analyzed the situation for clues that would help her solve the problem, and when he evaluated her problem by giving her advice on where to put her hook and how to jerk the rod. He experienced pleasure in assisting others by teaching them how to use successful fishing strategies, and he even stopped fishing himself to focus on his new role as educator.

Empathy emerged as a sub-category of Feher's (1990) level: experience. Many of the children experienced empathy for the hooked fish and were anxious to release them unharmed. Kate, Mike, and Jill also demonstrated empathy for one perch when the fishing pliers broke a hook, leaving the barb to remain stuck in the fish's mouth.

Lincoln and Guba's (1985) assertion that naturalistic inquiry always diverges rather than converges is evident in the data categorized for Feher's four levels of engagement in learning. (See Appendix E1 to E4.) Sensory experiences, such as feeling the slimy texture

of mussel tissue between their fingers, were common to many of the children in the study. However, the fledgling anglers revealed different perceptual experiences. Where one child (Kate) experienced frustration at not catching fish immediately when bait was presented, another child (Jill) perceived the situation as a playful game with the "fishies."

Appendix E1 begins with a list of sensory experiences, most of which were common to Kate, Jill, and Mike, as well as to the other children in the study groups. The findings revealed that while many of the sensory experiences were universal, some aspects of the experiences were specific to groups or to a specific child within the group. All of the children witnessed schools of perch swimming and feeding near the surface of the water around the float. Although fish were caught in each group, only Kate, Jill, and Mike saw a fishhook break in the perch's mouth. Another universal visual experience was seeing the variety of sea life on the mussel-encrusted ropes hauled onto the float's deck. Although the children saw the same ropes in each of the five fishing events, only two groups of children noticed and laughed at the action of the hairy sea squirts. All of the children engaged in the tactile experience of opening mussels, however they attempted, in unique ways, to get these to stay securely on their hooks. All of the children heard the raucous cries of sea gulls circling overhead, interested in the thawing herring bait visible in the bait bucket. Everyone, including me, experienced the kinesthetic effect of a passing boat's wake on the float. All of the children smelled the odour of decaying herring on their hands, however, only two children and I experienced the pain of a wasp's sting.

The findings of the study also show a noticeable increasing differentiation in the data for all of the groups from Feher's (1990) first level, experience, to the fourth level, extend. Appendix E2 lists the children's explorations and many of these were universal, such as pulling out line from the fishing reels as well as turning the reel handles and lowering their baited hooks to different water levels to test the effect on the perch. However the groups, and the children within the groups, were unique in exploring different ways of baiting their hooks, solving fishing problems, and using the fishing rods.

All of the children explored the "mooching" technique of still fishing and waiting for the fish to bite the baited hook, but only Mike noticed, and explored the effect of using, the black mooching line. Jill was unique in exploring the use of three pieces of one herring as bait on the large treble hook of a buzz-bomb lure and in leaving her rod lying on the deck with the baited hook dangling unattended over the edge of the float.

Busque (1991) observed that visitors' attention is held by the interactive and investigative potential of exhibits. The interactive potential of the float site was explored by the children as they interacted with the float site, the fish, the researcher, the parent with the videorecorder, and with each other. The investigative potential of the float site was also explored by the children as they investigated fish behaviour using the fishing equipment and bait choices in various ways.

The interactive and investigative potential of the fishing activity and the float setting includes the characteristics that Feher (1990) described for successful interactive exhibits: elements of surprise, opportunities to go messing about, and possibilities for asking What if? questions. Most of the children in the study experienced surprise as well as a thrill in finally hooking a fish and feeling the tension in their fishing line as the fish struggled to be free. They also experienced the excitement of watching their friends bringing in their hooked fish. The children who had gone fishing before were just as surprised and excited about catching a fish as were the children who had never experienced this event before. The children explored the mussel-encrusted ropes looking for mussels to use as bait and found unexpected surprises such as the squirting, hairy sea squirts.

The fishing activity gave the children an opportunity to "mess about" through explorations with a variety of rods, lines, lures, hooks, and bait choices. After finding mussels large enough to open, the children messed about trying to open them by stomping with their feet on the closed shells, squeezing them, or prying them open with fingers or the fishing spoon. The children quite literally "messed about" as they scraped the mussel tissue from the shells and searched through the slimy mess for the mussel's muscular foot.

Some children messed about when they explored using the buzz-bomb lure in unorthodox ways such as adding bait to the treble hook, using the lure as a cod jig by bouncing it off the seaweed bottom, or dragging it back and forth through the water along the side of the float deck so that it looked like a little swimming fish. They experienced the sight of the perch darting out from beneath the protective cover of the float and grabbing at the baited hooks.

The fishing activity and the float setting offered the children many possibilities for asking What if? questions, either aloud to others present or silently to themselves, as they pursued the secret to catching fish successfully. The children wanted to know: "What would happen if I jerk the line when the fish bites? What would happen if I use a combination of bait types on one hook? What would happen if I use a black fishing line instead of a clear monofilament one? What would happen if I use a starfish on my hook?" One girl, a novice at fishing, was delightedly surprised when she caught her first fish and this event motivated her to continue fishing by messing about with the equipment. She found out more about perch bait preferences by asking herself What if? questions as she explored using different bait types on her hook. As a result of her inquiry into fish behaviour, she also experienced satisfaction at having caught the second "catch of the day."

Asking What if? questions is an example of Schön's (1983) notion of reflection-in-action. Several children in the present study experienced reflection-in-action during the fishing activity and reflection-on-action during the follow-up interviews. When one child tossed bits of broken mussel shells into the water around the float she observed that the perch were very interested and darted out from under the float to investigate if any morsels of mussel tissue remained on the shell bits. She was reflecting-*in*-action when she said, "I'm going to do that again." During the follow-up interviews she reflected-*on*-action as she described how using mussel was more effective at attracting perch to her baited hook.

When the children arrived at the float they were anticipating an enjoyable afternoon of fishing with their friends. They did not expect to be confronted with problems that had

to be resolved, through reflecting-in-action, before the process of fishing could continue and the goal of catching a fish could be reached. The children in the different groups experienced similar perplexing problems such as the following:

- fish stealing the bait off the hook and not getting caught
- getting mussel tissue and frozen herring to stay on the hook
- hooks stuck on the seaweed bottom
- tangled fishing lines in reel or at rod tip
- rod too long to hold and still see over the edge of the float to see fish and baited hook
- fishing line won't go down when the reel is turned one way
- matching hooks to bait type and fish type
- hooks breaking or getting stuck in the float deck boards
- getting mussel tissue out of crushed shells and finding the muscular foot

Many of these problems are examples of Csikzentimahalyi's (1987) notion of "discovered problems," each having what he describes as "bits and pieces of tantalizing information" (p. 82). In one group activity, a small open boat was tied to the float and was available for the children to fish from if they wished. One boy discovered he had a problem in learning how to get into the boat while it bumped against the float while he held onto his fishing rod in one hand and a sharp baited hook in the other. When he enlisted the help of the other fishers to hold the moving boat, he climbed inside to fish. Thus, the children were intrinsically motivated to become involved as collaborators in determining alternative solutions to resolving many of their discovered problems. One girl solved the group's problem of the mussel tissue falling off hooks by suggesting, "You could use a different hook." The children demonstrated Bateson's (1994) philosophy of problem solving as they improvised responses from previous learning when faced with "moments of crisis."

Dewey (1902) believed that teachers should be concerned with "inducing a vital and personal experiencing" (p. 23), particularly the ways in which subject matter may become a part of experience. Dewey (1916) urged educators to deliberately create "problem intrigue" within a cooperative and collaborative context as he believed that a difficulty is an

indispensable stimulus to thinking. The problems the children “discovered” in their fishing activity were valuable as well as authentic learning experiences not only for the children but for me as well. Hennessy (1993) points out that

An increasingly large body of research shows that social interaction contributes to children’s cognitive development, and that collaborative problem solving is a key means of significantly increasing the chances of these outcomes (p. 11).

Question #2: How did the children share their experiences?

When “storying”—constructing stories in the mind—becomes overt and is given expression in words, the resulting stories are one of the most effective ways of making one’s own interpretation of events and ideas available to others....Through the exchange of stories teachers and students can share their understandings.... Stories offer a personal interpretation of experience.

Gordon Wells (1986, p. 194)

Conversations among the children and the researcher has been the main form of data collection in the present study. The children shared their fishing experiences, perceptions, and learning through “storied” conversations with others on the float. Wells states that “making sense of experience is to a very great extent being able to construct a plausible story about it” (p. 196). He argues that because the stories occur in

the context of social interaction and are produced in conversation, they are jointly constructed....In this way members create a shared interpretation of experience, each confirming, modifying, and elaborating on the story of the other (p. 195).

Mike spoke of his concern that he might catch the seal with his buzz-bomb lure as he cast it. Kate confirmed his story by saying, “Yeah. What if we catch the seal?” Jill modified the story by naming the seal André. She elaborated the story by predicting what André might be doing during their fishing activity such as having fun riding the waves that bounced the float up and down.

Metaphors convey meaning. People think in metaphors, linking one experience to another, and learn through stories (Bateson, 1994). The children brought their experience

to a frame of interpretation (Erickson, 1986) as they developed analogies to describe their visual observations to others. One child thought the shiner perch around the baited hook were playing a game of tug-o-war and that they were acting like a team. Another child thought that the hairy sea squirts looked like strawberries. Mike thought that jigging his line was a good idea because the lure "looks like it's alive." When a sea cucumber was caught on a hook and hauled on to the float, one child said it was "bumpy, hard, and slimy like a pickle." Many of the children noticed that the perch would dart out from beneath the protective cover of the float to inspect bits of mussel shells tossed into the water. One girl brought her experience to a frame of interpretation by developing a dishwasher analogy: "When you throw in the hard part of the mussel, like the shell, it's like the dishwasher. It has all the dishes with the food stuck on. It's like the fish. The fish clean off the shells."

In assessing the learning potential of science centers and museums, Falk, Koran, and Dierking (1986) generalized that cognitive learning was likely to occur at any exhibit at which a visitor spends a "significant" amount of time engaged in appropriate behaviour for the exhibit. During each two-hour fishing event, ample evidence was generated from the data to indicate that cognitive learning (as well as affective learning) had occurred. Some of the learning was universal among the children, such as the insights into perch's bait preferences and the usefulness of the mussel's muscular foot when baiting hooks. Some of the cognitive learning was specific to individual children or to their group, such as the realization that fish hooks do break, but they eventually rust away in salt water. A list of universal and specific examples of cognitive learning among the children is presented in Table 2. The table is helpful in reflecting on the kinds of learning experiences that the children shared with the other participants. As Browns, Collins, and Duguid (1989) point out, "what the children perceive contributes to how they act and learn" (p. 36).

Table 2

Evidence Of The Children's Cognitive Learning During Their Fishing Experiences.

Some Examples Of Cognitive Learning That Was Universal Among The Children:

- Mussel flesh is more effective than herring as bait for certain fish (such as perch).
- Caught fish can often be released alive.
- Wasps are attracted to the odour of decaying fish and crushed mussels.
- Mussels grow abundantly from surfaces beneath floats such as the dangling ropes, but they are scarce in the shore's tide zones.
- Mussel tissue is soft and delicate, but it has a tough muscular foot that is easy to find.
- The head of a herring used as bait is much larger than the mouth of the shiner perch.
- There are different kinds of fish hooks, fishing lines, rods, and reels.
- Shiner perch prefer mussel tissue as bait over herring pieces.
- The ropes dangling beneath the float are encrusted with mussels and other creatures.
- Some fishing strategies (e.g.: jigging the hook, casting line out) are better than others.
- A passing boat's wake makes the float creak up and down.

Some Examples Of Cognitive Learning Specific To Individual Children Or Their Group:

- Colored fishing lines such as the black braided cord do catch some fish such as perch.
- Fish can be snagged on exterior body parts as well as hooked in the mouth.
- Metal fish hooks can break, but they rust away in salt water.
- The ramp holds the float in position, and the hinge allows the float to rise with the tides.
- Seals have very small ears.
- Sea worms make good bait for some fish.
- Chitons, sea stars, and hairy sea squirts grow on the ropes dangling in the water.
- Different hooks hold different types of bait. So if the bait won't stay on the hook, try another kind of hook.
- Fishing rods have different parts (reels, rod, holes, handle, metal bars).
- Herring don't live under the float.
- Herring swim faster than perch because they're lighter.
- Perch can't swallow the whole herring at once.
- Sea cucumbers are bumpy, slimy, and full of water.
- Rock cod have many sharp dorsal spines.
- Shiner perch have three wide vertical yellow stripes on each side.
- Different species of perch are found beneath the float (shiners, striped, and pile perch).

Feher's (1990) findings on levels of engagement in learning were evident in the present study as many of the children shared their fishing experiences through personally meaningful explanations that they constructed: "The fish are smart because they don't seem to get hooked," "The perch are eating the stuff on the ropes," "You have to keep moving the bait around so they can find it," and "The mussel is hard to put on the hook because it's too slippery." Appendix E3 lists the explanations of Kate, Jill, and Mike, and the increasing differentiation in the levels of engagement is very evident. These children, as was observed in the other groups as well, found unique ways to make sense of their common experiences and explorations: "Fishing takes patience." "The fishies know what's going to happen!" "Mussels were on the ropes because predators don't come this shallow." Osborne and Wittrock (1983) argue that

To comprehend what we are taught verbally, or what we read, or what we find out by watching a demonstration, or doing an experiment, we must invent a model or explanation in a way that makes sense to us, that fits our logic or real world experiences, or both (p. 493).

The children invented a "model" or explanation of the school of perch nibbling at the baited hook. The way for one child to represent this explanation—a way that made sense to her and that fit with her logic or real world experiences—was to call their behaviour a "tug-o-war," something the child may have done with her friends on playgrounds. Some of the children explained that the perch were nibbling at the bait so that they could all share it. Most of the children noticed that the perch didn't seem to be as interested in the herring bait as they were in the mussel tissue. One girl invented a model to explain this observation that was personally meaningful to her:

I don't think the fish like the outside of the herring because everyone's been touching it, so probably if you cut the skin off and you don't touch the inside, they would probably get it.

The children also invented personally meaningful and logical models to explain the "mussel issue," why the mussels were in abundance on the ropes dangling beneath the float but were scarce in the tide zones:

- “Maybe because it’s deeper here. All the food is in the deep water.”
- “Because it’s deep for them here but it’s too shallow for them up there.”
- “They like living underwater better.”
- “Probably ‘cause there’s no food on the shore.”
- “There’s not much tiny plants at the shore ‘cause some kids like pouncing on the rocks.”
- “The waves,...because the water comes in and washes it away.”
- “Because the ropes have got salt on them.”
- “Because predators don’t come this shallow.”
- “Maybe because the humans could catch them easier because they’re at the shore.”

Feher and Rice (1985), in their study of the development of scientific concepts through the use of interactive exhibits in museums, used post interviews to gather data as I did in the “Catch of the Day” case study. They categorized responses to their interview questions to help determine how learning occurs and how it can be enhanced. The responses shared by the children during the informal, conversational interviews for the present study fit loosely into two of their categories: (1) responses that restate experience but give no explanations, and (2) responses that explain.

An analysis of the interview data revealed many instances of the first category: simple restatements of their fishing experiences. For example, when I asked the children, “What kind of bait did you use to catch these fish?” they gave a unanimous response that restated their observed experience: “Mussels!” When I asked, “What have you learned about fish behaviour?” some said, “They all came nibbling at it,” and motioned with their hands to show the fish’s behaviour.

Many of the children also responded to the interview questions by giving explanations. I asked one boy what he was doing with the casting rod, “Were you using a new strategy with the buzz-bomb?” He explained, “I was just pretending I was a little fish jumping out of the water trying to attract fish. I was just lazy. I didn’t want to put any more bait on. So I was just playing with the buzz-bomb.” When I commented on the large clump of mussel tissue that one child held up as a close-up for the camera, “So, do you

think it'll be one fish that'll get all that?" the child responded with a lengthy explanation that also restated her experience:

Probably lots of them so they bite more often. There's that tough part. So you put that part on your hook so that it stays on there and most of the rest of the mussel gets stuck on to your hook. Yeah, they're all biting. They're all nibbling to make it small so the fish could swallow it. So they're working like a team. I tried the herring and the mussel, but they just took the mussel. I tried the herring and the mussel together but it didn't work 'cause all the fish just wanted the mussel. All the fish bite it so it's smaller so one fish can swallow it. They work as a team.

When I asked one boy what he was thinking when he felt something heavy on his line, he explained, "I thought it was a big salmon 'cause it weighed a lot." When I asked the groups of children, "Do you think those pile perch eat herring normally under the float?" many replied, "No," simply restating their observed experience. One boy clarified his response with the following explanation: "No, 'cause they don't have any teeth so they can't bite and grab it." I asked the children to reflect on how learning about fish and fish behaviour under the float was different from learning about these things in school or from a textbook. Most of the children said the fishing experience was more fun, however one child added, "You know with the mussels, we could actually see where the foot is." I felt it was her way of explaining the relevance of knowing where the mussel's foot is in the context of fishing, as compared to learning about it as irrelevant, decontextualized knowledge in school.

While I was asking questions during the group interview, the children also asked questions. One girl, reflecting on her experience that mussel tissue is preferred by perch over herring bait, asked, "When the rope is down and all the mussels are on them and they're closed, how do the fish get to the mussel. Like how do they break it open? They don't have teeth." The discussion was causing her to experience conceptual conflict and she experienced an immediate need to know the answer. Another child responded to her puzzlement with an explanation that seemed plausible to him: "Sometimes it'll open up to get its food and that's when they might want to go and get it, or when it leaves its shell to go make new shells." Rather than try to correct the child's misconception about mussels

and how they grow, I decided to pursue the concept of mussels opening up their shells: "So it if opens up a bit like that, if the fish had a big mouth or a little mouth, which would be better to try to get what's inside that?" One child responded with an explanation: "A little one because it can nibble."

The children also shared their experiences when they extended their understanding of the fishing phenomena, and the examples listed in Appendix E4 showed the most differentiation among the children: "The perch were playing tug-o-war so they were working like a team." The jellyfish wasn't a fish because "it doesn't have fins or a backbone." "I smell like salmon," and "Salt water rusted things made of iron." One boy, listening to another child explain that perch "don't like the outside of the herring because everyone's been touching it," extended his understanding of animal behaviour when he shared with the group; "That's like with birds. They don't like the scent of humans on their nest, 'cause we'll be able to get them."

Some children shared their experiences with a sense of humour: "I'm fishing for a shark, or maybe a beluga whale." "I'm waiting for the fish to jump up and get stuck." "I wish this herring bait would fall off so I don't have to take it off." "I'll bet the fishies know what's going to happen!" and "Fishing does take patience." One child sang "Born Free" while watching another child release a caught fish.

Storied conversations are the main ways that children shared their fishing experiences. White and Gunstone (1992) believe that young children need to formulate their ideas through conversations before expressing their ideas in writing. However, drawing is also an effective approach that helps children formulate their ideas first so that they can write about them afterwards. This is a significant implication for educational practice in classrooms.

After the fishing activity and group interview, the children were invited to draw as a way of sharing their experiences. (See Appendix C for examples of children's drawings.) Children's drawings reveal Polanyi's (1966) notion of "tacit knowledge,"

knowledge acquired through practice that cannot be articulated explicitly. Polanyi believes that we know more than we can tell, and we tell less than we know. Drawings offer a more imaginative and powerful way to assess the understanding of young children who may not have the vocabulary to express orally or in writing what they have learned in the fishing experience. The children's drawings of their hands-on fishing activities represent Dewey's (1938) notion of "an intellectual revisiting" for the children have reflected through their art on their learning as well as their experiences.

Drawings not only provide an opportunity for children to represent their knowledge in another way, they also provide time needed to stimulate children's thinking. Grumet (1992) describes an encounter with the world as "a generative act, a spawning experience, a hybrid of objectivity and subjectivity" (p. 29). As the children are engaged in drawing, they are also evaluating their fishing experience, making connections to prior knowledge, and interpreting the experience. The time taken to draw promotes speculation: generating questions and seeking answers to them. Constructing questions such as "What holds the float down?" is a way for children to build conceptual conflict, which can be resolved by seeking answers: "the ramp." Eisner (1991) sees art as "one of the tools we use to help us keep our perceptions alive" (p. 18).

White and Gunstone (1992) assert that non-verbal images can be used to communicate understanding of the main ideas in science. These researchers advocate the use of drawings as an effective way to probe understanding because

Drawings are very open, with few limits on how the student may respond. They allow the teacher to see, and the student to reveal, qualities of understanding that are hidden from other procedures (p. 98)...with a directness that is more compelling than is possible through words (p. 101)....Drawings tap holistic understanding. They allow expression of attitude or feelings as well as cognition (p. 104).

Creating a drawing of the fishing experience is a direct and compelling way to reveal holistic understanding and is an effective approach to promoting metacognition. In Bloom's terms, drawings involve: (1) analysis: breaking down cognitive learning into parts that can be represented in a drawings, such as the float, ramp, and children fishing;

(2) synthesis: reorganizing information so that a new structure emerges, as in the addition of humour in drawing hungry sharks beneath the float (See Appendix C, Drawing # 1); and (3) evaluation of information: checking to see that each part of the drawing is congruent and coherent.

Wells (1986) suggests that "instead of drawing what they see, children try to represent what is essential about the subject as they have understood it" (p. 151). (See Appendix C, Drawing #1, #2, and #3). The act of drawing helps children become metacognitive as they gain an awareness of when they understand or do not understand. For example, one child paused reflectively while drawing to ask, "What holds the float down?" He had noticed one child drawing the ramp holding the float in place and another child drawing an anchor holding the float to the sea bottom. (See Appendix C, Drawing #1.) He advised the latter child to "draw a lot of chain because the tide goes up and down." He has apparently drawn on his previous experience of seeing boats anchored with chains that allow for the motion of the tides. Another child also paused reflectively while drawing to ask if the seal that hung around the float had ears. As she was drawing the seal's head, she realized that she couldn't remember if they had ears or not, but she wanted her drawing to be accurate. (See Appendix C, Drawing #2, for the seal's head in the top left corner of the drawing.) Drawing #3 contains all the essential elements of the fishing experience: children fishing, the researcher wearing glasses needed to see when baiting hooks, the parent operating the videorecorder, the bucket of bait, the net for catching big fish, and of course the schools of fish. The smiles on the faces of everyone depicted tells a lot about how this eight year old girl perceived fishing.

By stretching their imagination through drawings, children come to value the activity as an appropriate and meaningful way to assess their own learning. Driver and Erickson's (1983) studies indicate

the human qualities of imagination and liveliness of thought which students are capable of when attempting to make sense of new experiences and use their ideas in the solution of problems...the "student as scientist"...requires opportunities for young people to explore both new phenomena and new ideas;

to construct their own knowledge and perhaps gain some appreciation of science as a pursuit of the human imagination (p. 55).

Another child in the study enjoyed the presence of the videocamera and used it as a way to stretch her imagination as well as share her experiences with the others. Like Jill, she too used a story-line to make sense of her on-going experiences. However, she had spontaneously invented a role for herself, pretending as if she were a reporter giving an on-the-scene documentary for her TV audience. "Look at this bait," she grinned confidently. "Here, I'll bring it up for a closer look. Here we go. We're gonna let it down. They'll all be fighting over this one!" Her journalism story was created as she told it, an expression of her attempts to find meaning in the fishing experience. Even for journalists who are on location reporting news events as they occur, the construction of meaning from their point of view is a continuous and active process. Wells (1986) argues that "seen from this perspective, there can be no true stories. The evidence is never so complete or so unambiguous as to rule out alternative interpretations" (p. xii).

I reviewed the videotape of the fishing activity as a vicarious observer, looking to see if the budding journalist was "playing to the gallery" (Lucas and McManus, 1986) in the presence of the video recorder. However, as I watched her, I observed the same kind of behaviour that I had observed many times in our classroom together the previous year. She is a confident and verbally articulate nine-year-old girl who enjoys telling stories. I believe that she perceived the camera's presence as a new way to create and tell her stories, rather than as an opportunity "to play to the gallery" (her mother) on the ramp. She was giving what McManus (1992) would describe as "a spontaneous unsolicited sharing and broadcasting of commentaries" that often occurs in effective informal learning environments such as museums, and in this study, fishing off a marine float. "The fish was smart. It took my bait. See that? An empty hook," she reported to the camera, and then later on: "See this? There's herring on. Herring and mussel together."

Driver and Oldham (1986) believe that the teacher's role is crucial in encouraging children to share their experiences. In their view of constructivism, the teacher is not viewed as a transmitter of knowledge but as

someone who facilitates conceptual change by encouraging pupils to engage actively in the personal construction of meaning. In order to do this, there needs to be frequent opportunities for pupils to make their ideas explicit and to communicate them to others (p. 116).

Hennessy (1993) believes that teachers can facilitate conceptual change through a series of processes such as:

modeling, coaching, scaffolding, fading, articulation, and encouraging learners to reflect on their own problem-solving strategies. These processes are components of apprenticeship (p. 11).

Sharing their experiences through storied conversations, impromptu documentaries for the video camera, humour, and detailed drawings helped the children make their ideas explicit. Each act of sharing was "a way of being in the social world," as well as a way of coming to know about it.

Question #3: What were the children's perceptions of fishing?

Kuhn (1962) describes a paradigm as "a constellation of beliefs, values, and techniques" (p. 175). He believes that

Something like a paradigm is prerequisite to perception itself. What a man sees depends both upon what he looks at, and also upon what his previous visual-conceptual experience has taught him to see (p. 113).

Thus, the children's perceptions of the fishing experience depended not only upon what they saw and engaged in on the float, but also upon their prior knowledge and previous experiences. "In every act of perception," states Wells (1986), "the world 'out there' is interpreted in relation to the inner mental model in terms of which that world is represented" (p. 196). Eisner (1991) believes that we are always in a constructive position: "We make our experience, not simply have it" (p. 60), and that perception of the world is influenced by skill, point of view, focus, language, and framework. These elements became apparent

as the children shared their experiences, explorations, explanations, and perceptions of the fishing activity.

The children in each of the groups arrived at the study site predisposed to become engaged in an activity which they all perceived as interesting and enjoyable. Falk, Koran, and Dierking (1986) describe this predisposition as an "appropriate learning set" (p. 506). However, during the fishing experience, the children's perceptions diverged from initial eager anticipation to a wide range of human emotions:

- frustration: "But I haven't even caught a fish yet!"
- pessimism: "No one will ever catch a fish off this dock."
- confidence: "You have to jig your line, that's how to catch 'em."
- happiness: "Oh! They stole my bait! Those bad fishies!"
- empathy: "Will it kill him though?"
- competition: "I was here first!"
- pride: "My first fish in my whole life!"

Brown, Collins, and Duguid (1989) believe that "*What* the children perceive contributes to *how* they act and learn." There was evidence in the study's data to support this assertion. Mike perceived that fishing success could be achieved by using his acquired skills and "know-how." He acted accordingly and explained what he was doing and how he caught his fish: "You have to jig the line so the fish think it's alive." Kate perceived fishing as a frustrating experience, so she acted by following a step-by-step approach which copied Mike's procedure. Jill perceived fishing as a spontaneous and playful adventure. She acted with a "hit-or-miss" fishing strategy that was game-like, rather than serious, in its intent. Another child, who enjoys interacting with me as her science teacher, perceived fishing as another fun, hands-on science activity. She perceived fishing as an opportunity to verbalize her learning about fish behaviour, so she acted in role as an on-the-scene reporter for the video camera and gave an impromptu documentary on the fishing events including close-ups of the mussel's foot.

Some of the children were novices at this ancient activity as they had never held a fishing rod or a live wriggling fish in their hands before. Other children were skilled at using the nine foot spin-casting rod and reel to make the buzz-bomb lure simulate the movement of a wounded fish. The children began to “fish” as soon as they got to the float. Some children knew that bait was needed on the hook first, and others simply used a bare hook or lure at the end of their fishing line. Some children used hand nets to try and scoop fish beneath the float. One child attached a small hand net to his fish hook and lowered it to try and catch fish beneath the float. Others used a hand-line on a simple wooden holder with a weighted line and baited hook lowered over the edge of the float. All of the children were building on their prior knowledge that an appropriate fishing tool was needed to catch the perch swimming visibly around and beneath the float.

Kate demonstrated evidence of prior knowledge when she referred to Mike’s perch as the first “catch of the day.” This catch phrase is often used on restaurant menus and on signs in fish markets. She believed that the first catch of the day could be followed by a second or third catch if she could just copy Mike’s technique exactly. When I asked the children, “What’s the best bait to use to catch fish?” Mike revealed his prior knowledge and experience with fishing when he replied, “It depends on what you’re fishing for.”

Some of the children’s perceptions of the fishing experience were shaped by vicarious learning as they watched others engaged in fishing off the float. When one child added a piece of herring to the lure’s treble hook, another child reasoned that adding more pieces would be even more effective at attracting fish to the hook. Some children experimented with two kinds of bait on one hook such as mussels and herring together. Other children considered this bait combination to be a good fishing strategy as they saw fish attracted to and being caught on the baited hook. Several children had prior experience in opening mussels and scraping out the flesh to use as bait. The onlookers were at first reluctant to try to open and scrape out the shells, but when they saw that this bait type effectively attracted perch to the baited hook, they learned to set aside their squeamishness

and search through the slimy mess for the mussel's tough muscular foot to impale on the sharp hook.

The children engaged in the fishing activity with varying levels of expectations for success in catching fish. One child learned that even though she had lived in the Arizona desert for the last four years and had never fished before, she caught the first two fish of the day. She saw that this activity could be done by a novice such as herself. With a similar expectation for success, another child announced positively, "Any one can catch a fish." However, a young teen in a different group predicted pessimistically, "No one will ever catch a fish off this dock." He is aggressively competitive in hockey, but a novice at fishing. He may have perceived that he was unskilled in angling techniques and therefore he probably thought he wouldn't be successful at catching fish.

One child introduced an element of territorial behaviour and possessiveness to his group on the small float rather than the joint accomplishment of tasks, perhaps perceiving that his behaviour would be rewarded with a successful catch: "That's my spot. I was there first! No, I'm fishing from the boat." This was the only incident of competition in the study, although as I revisited the videotapes and transcriptions I noticed that I had asked the children, "Who's going to catch the first fish? Someone using herring or someone using mussels?" Another child in the same group was so thrilled with her two catches that she suggested others should use her lucky spot on the float so they could catch fish too. The data collected from the other fishing groups support Falk, Koran, and Dierking's (1986) belief that the informal setting, even in a confined space such as the float, promotes collaboration rather than competition.

The children in the study exhibited a range of reactions to catching fish. One group of children who had never fished before and seemed startled at the sudden catch initially reacted with cries of "Quick! Step on it! Step on it!" Some children dropped their catch to the float with a shriek or a shudder when the fish wriggled unexpectedly. Some of the children perceived the fish they caught as beautiful creatures to be released unharmed:

"What a beauty! You're free little fishy!" Eventually, all of the children appreciated the fish as living creatures that needed fresh salt water to survive and that couldn't live long swimming in circles in the bucket of sea water on the float. One child in the study regarded the fish as a creature with feelings, for she apologized to it in the bucket and was anxious to let it go. "I'm so sorry fish, but I didn't think I could catch you." Like many of the children in the study, one child seemed to breathe a happy sigh of relief as he released his catch of the day and watched it disappear beneath the float again: "It's still alive." One fish that was released with the children's best intentions continued to float lifelessly on the top of the water as the fisher announced, "It's dead." The children, speechless, watched as it drifted out of sight.

The children in several groups, especially the older children who were casting with the buzz-bomb lures, expressed concern about the possibility of catching a seal which they had seen swimming under the float and frolicking in the water nearby: "What if we catch a seal?" When Jill named the seal André the children seemed even more anxious not to catch it with their fishing hooks.

Many of the children perceived the fish to be "pretty smart" as the perch had strategies of getting their bait and not getting hooked. One girl observed the fish in a large group all trying to get at her baited hook at the same time. In trying to find an analogous situation from her own experiences to explain the fish's behaviour she noticed that the fish were tugging at the bait, and hence described their activity as a popular child's game often played on school grounds: "Oh! Look! There's little fish playing tug-o-war! They're playing tug-o-war!" Later, in the follow-up interview I asked her to explain why she thought that playing "tug-o-war" would be a good strategy for the fish. "They're all nibbling to make it small so the fish could swallow it," she rationalized, and she concluded by adding thoughtfully, "So they're working like a team." Since tug-o-war is a game played by two teams, she perceived the perch's behaviour to be team-like.

The heterogeneous groups of children on the float were also working like a team helping each other to be successful at catching fish, sometimes in barely perceptible ways. For example, when I asked one boy if a small piece of herring would be more effective at catching fish than a fat mussel, he replied, "Maybe. It depends on what you're going for. For piling perch, mussel would be better." He had constructed meaning from his own personal experiences with fishing in an authentic learning environment such as the float. From a constructivist point of view, meanings once constructed are evaluated and can be accepted or rejected (Driver 1987). Another child heard his comments, internally evaluated them, and decided aloud, "I have to get some mussels." She had accepted his meanings as she perceived the older boy to be more knowledgeable about fishing matters, and she perceived this knowledge would be helpful to her in the task of catching a fish.

His thoughtful response to my question about bait, followed by the girl's resolve to get mussels for bait, is an example of Hilke and Balling's (1989) finding that the information each person is exposed to is heavily influenced by other family members. In the present study, information exchange also occurred as spontaneous unsolicited sharing and broadcasting of commentaries. The older boy's comments had influenced the girl's decision to choose mussels over herring when she baited her hook again. He also influenced her when he broadcast the news that "The fish are right down here! They're all around this pole here! Yeah, you can see them!" On hearing this news, she and the other children in the group reeled in their lines and she said, "I'm gonna move over there."

Two children used the word "nibbling" in their dialogue just as Mike and Kate did in their conversations. However, the two pairs of children used the word in a slightly different way to express their different interpretations of what the word meant in context. Mike and Kate used "nibble" to express their meaning of fish taking small bites in order to avoid the sharp hook. The other pair of children used the word "nibble" to express their observation that the perch were all taking small bites cooperatively in order to make the bait smaller so it could be shared among them.

As the children fished with their friends, they were also using science process skills and acquiring knowledge in marine ecology. (See Table 2 for a list of examples of the children's cognitive learning during the fishing activity, some that are universal among the children and some that are specific to individuals.) For example, many of the children learned that the marine float is the site of a unique ecological system because it provides a protected habitat for many species of organisms which cling to it and the ropes dangling from it. The children discovered that if they tossed bits of broken mussel shells over the edge of the float, the shiner perch would dart out from underneath the protective cover of the float and investigate them. The budding journalist called out, "Come here. Look at that. Look at these little fish. I threw a little piece of mussel so they'd all come out. I think I'll do that again." She was giving another spontaneous unsolicited broadcast commentary (Hilke & Balling, 1989), while at the same time acquiring insights about fish behaviour.

Price and Hein (1991) suggested that effective informal learning environments such as museums concentrate on higher learning skills such as observation, questioning, and exploration rather than relying on just the acquisition of basic facts. The children were immersed in an informal learning environment as they fished from the float with their friends. As they explored the float site's phenomena, they used a variety of higher-level thinking skills. The children carefully observed the perch's behaviour as they lowered their baited hooks over the edge of the float. One child perceived that the perch preferred "the mussel rather than the herring because I guess it has...it's slimier." She inferred that the perch "probably don't like the skin." When I wondered aloud why the mussels were on the ropes but not on the shoreline, her observations lead her to infer that the mussels were on the ropes because "It's deeper here...and 'cause by the shore...it's too shallow and there's little tiny animals."

Like Kate, the children in this fishing group expressed some frustration while fishing. One child was annoyed by the wasps and suggested, "Let's bug spray them."

Getting the line on the reel to go down when she turned the reel handle was problematic for her: "It's bugging me." Another child was also annoyed with the wasps and somewhat irritated when she realized that she was having trouble getting the bait to stay on her hook: "I can't put my bait on properly. The foot won't go on," she complained.

The fishing experience aroused a personal response (McManus, 1992) in most of the children in the study. They all felt compassion for the hooked perch and were eager to release their catch of the day. To the video camera audience, the journalist announced, "It's a beauty. You're free little fishy!" while one child sang lines from the song Born Free.

In naturalistic inquiry, the qualitative researcher interprets data as it occurs. "We always bring to experience frames of interpretation" (Erickson, 1986, p. 140). Boostrom (1994) points out that the "aimless eye of a video camera presumably records accurately but sees nothing of significance" (p. 54). It is the researcher's task to discern moments of significance when interpreting the data gathered from personal observations of the interactions in the fishing experience, the video transcriptions, and the informal interview sessions with the children. However, Kuhn (1962) argues that "each of these interpretations presupposed a paradigm" (p. 122). That paradigm involves the combined perspectives of constructivism, situated cognition, and naturalistic inquiry.

Geertz (1973) points out that "what we call our data are really our own constructions of other people's constructions of what they are up to" (p. 9). When one child announced that the fishing activity is "funner than I thought," the researcher interpreted the statement to mean "it is more fun than I thought it would be before I came here today with my friends." This child was later stung by an angry wasp, and this painful event could influence her overall perceptions of the fishing experience.

Personal Reflections On The Fishing Experience

What does it mean to be a fisher? Fishing is an ancient activity that harkens back to the early hunter-gatherer societies in which members of a group would forage for food,

often for the benefit of all. In this way, it offered the fishers a sense of belonging to the group and an attitude of community spirit. Fishing is a centuries old practice that has been enjoyed and pursued as either an individual or a social activity, and it is still an activity that people of all ages look forward to engaging in, either alone or with friends, from shorelines or from boats, in fresh water lakes or in salt water. Learning how to fish is, indeed

a process of enculturation or individual participation in socially organized practices, through which specialized local knowledge, rituals, practices, and vocabulary are developed....Knowledge moves from being private to being shared through engagement in socially shared activity and discourse (Hennessy, 1993, p. 2).

Nuttall (1980), a local fishing enthusiast, believes that mooching for salmon is increasing in popularity because "it is an engagement which utterly captivates the participant" (p. 9). Personal observations and the videotapes of the fishing experience revealed that the children in the "Catch of the Day" study were utterly captivated by the fishing experience. When the children's concentration was intense, they "lost the sense of time as well as the sense of self" (Csikszentmihalyi, 1987, p. 85).

Unlike other hunting activities where the prey animals (such as moose, deer, elk, beaver, seals, and geese) can be seen by the hunter, fishing is unique in that the fish are usually hidden from the fisher's view beneath the surface of the water. This aspect offers an element of mystery to the activity as well as a sense of challenge to the fisher who must be alert to any action by the hidden fish to the rod tip.

Nuttall (1980) believes that most people enjoy fishing but some have given it up because the success factor was not there. In the present study, I increased the probability of success by conducting the fishing activities during late summer when perch are abundant around marine floats. However, most of the children seemed to enjoy the fishing experience whether they caught fish or not. Nuttall explains that the use of the word "mooching" probably arises from the original dictionary meaning which is "to amble, saunter, or wander aimlessly." To be a fisher is to amble, saunter, or wander, but not

always aimlessly. Whether the aim is to catch fish or just to drop a line over the edge of a float or boat while enjoying the company of others, fishing engages people of all ages.

Whitehead (1932) offers clues that describe the fishing experience and what it means to be a fisher, even though he is talking about "science":

Its task is the discovery of the relations which exist within that flux of perceptions, sensations, and emotions which forms our experience of life. The panorama yielded by sight, sound, taste, smell, touch, and by more inchoate sensible feelings is the sole field of activity. It is in this way that science is the thought organization of experience. The most obvious aspect of this field of actual experience is its disorderly character (p. 157).

The actual experience of fishing is certainly "disorderly" in character, with a flux of perceptions, sensations, and emotions. Even in the disorder, children discover the relations which exist in nature within that flux. Hence fishing, like science, can be thought of as the thought organization of experience.

Nuttall describes mooching for salmon as "an art; a delicate, sensitive, and highly developed art requiring substantial skill and knowledge" (p. 9), but he also points out that "because mooching requires a minimum of muscle and a maximum of concentration and skill, it is attracting more and more women" (p. 9). Even the word "fisher" is being used more often to replace "fisherman," especially in newspapers and television and radio newscasts, to reflect the active participation of women in commercial and sport fishing.

One of the main concerns of science educators is how to involve girls more in science education so that they can pursue science careers. The fishing experience clearly engaged the attention of all of the girls who participated in the study, even if they perceived themselves as novices. There was no evidence to suggest that the girls felt they were competing with the boys, as they often feel in classroom science lessons. The girls perceived their success was due more to luck or adhering to a procedure such as copying another fisher's strategies. They were eager to share their successes with the others as they felt they were on equal grounds with the boys, some of whom had more fishing experience. Learning how to fish has many important implications for education, especially the education of girls in science classrooms.

Experienced fishers know that once a fish is hooked, the line tension needs to remain taut, rather than loose, so that the fish can't "throw the hook." Excited fishers often announce, "Fish on!" to alert other fishers to the tension they are about to enjoy. Tension is also a recurring theme in the "Catch of the Day" case study. The children's Fish Tales engage readers with dramatic tension between the fledgling fishers and the fish, tension that is relieved when the children finally land their "catch of the day." The children experienced tension as fishers in many ways: feeling the tug of a hooked fish on their lines, struggling with a fish hook stuck on the sea bottom, tangled lines and reels, tension between the wasps and the fishers, the tension between competition and collaboration, and wondering if released fish would live.

Piaget thought that learning involved the tension between the comfort of equilibrium and the discomfort of disequilibrium and that the teacher's challenge was to keep the tension in the right proportion, or "taut." I experienced tension between my role as a teacher and my role as a participant observer and fellow fisher, between viewing marine education as a teaching curriculum and a learning curriculum, and between viewing fishing as a lifetime leisure skill and a vehicle for accomplishing educational objectives. Ideas about fish and perspectives on fishing ebb and flow in a social, recreational context of fishing with a group of friends.

Summary

Stake (1994) suggests that "a case study is both the process of learning about the case, and the product of our learning" (p. 237). The present case study is the "Catch of the Day" as it captures the perceptions and experiences of the children at a specific moment and place in time. The "facts" in this case study are not lined up neatly as Carr's (1967) fish on a fishmonger's slab, but are gathered in the study as a disorderly array of perceptions that

shape and are shaped by the participants' experiences. The children's Fish Tales revealed how children's perceptions together with prior knowledge and experience affected how the children acted and learned within the social recreational context of fishing with friends. The Fish Tales also told the story of how the children made sense of their experiences in a way that fit with their logic. The "Catch of the Day" case study has what Geertz (1973) calls "thick description" as it penetrates the surface of the fishing experience, beneath the children's manifest behaviour to the meaning events have for them.

Strengths of the Study

A strength of the "Catch of the Day" study is that the fishing activity provided opportunities for the children to exercise choice in determining the most successful match of rod, hook, and bait types for catching fish. As the children evaluated these decisions, they constructed new knowledge about fish behaviour, effective fishing strategies, and marine ecology. Another strength of the study is in the variety of intriguing "discovered" problems that emerged from the naturally occurring dilemmas the children encountered in their quest for a successful "catch of the day." The present research may also prove to be just the beginning of an information-rich study of a new generation of anglers engaged in a very ancient social activity. As Mary Catherine Bateson (1994) once said, "Because it is impossible to step into the same river twice, one can learn from each return" (p. 44).

How The "Catch Of The Day" Study Supports And Extends Research Findings

The "Catch of the Day" field study supports Feher's (1990) finding that users' experiences and explorations precede their explanations, and Carlisle's (1985) observation that children tend to explore first by themselves and then to share with others, often in role as explainers. The study also supports Feher's (1990) observation that children first

undergo an experience in which they actively participate, and then they give meaning to the experience through their own interpretations and explanations. The children did bring intuitive notions to the novel situations in their fishing experience, and these notions shaped their interpretations of the observed phenomena. Feher's observation that children do not necessarily confront their own misconceptions when learning from the exhibits and may instead construct models which build on these misconceptions was also apparent in the present study as the children built on their misconceptions of the "mussel issue" in different ways: "They like deeper water better," and "Predators don't come this shallow."

The "Catch of the Day" research also supports Stevenson's (1991) study on family groups at interactive centers which observed that children spent most of their time in social interaction and information exchange with others rather than spending a lot of time rushing about the exhibits. Most of the children in the study remained on the float engaged in fishing, and some left only briefly when the wasps became a nuisance.

The "Catch of the Day" study provides evidence that extends Feher's (1990) notion of levels of engagement in learning to include the following sub-categories: experiment, empathize, and teach. The study also supports and extends the literature in the field of informal learning which suggests that children draw analogies from events familiar to them to explain novel problem situations. They use metaphors and storied conversations to convey meaning. The children used their prior knowledge while investigating fish behaviour to construct plausible hypotheses about the phenomena exhibited. The study provides further evidence that children of varying ages and abilities influence each other in a collaborative learning process and that the activity and the social context are integral to learning and important in moving children beyond 'Gee-whiz!' experiences to 'Aha!' moments of insight and understanding.

Implications For Teaching Practice

“Catch of the Day” is a case study that observed children within a social context as experiencers, explorers, explainers, and expanders of knowledge and skills beyond “Gee-whiz!” thrills to “Aha!” understandings. Determining the kinds of social interactions that enhance collaborative and individual learning in informal social contexts provides many implications for educators on how they could plan more effective science experiences. Encouraging the exchange of information in small collaborative groups, providing authentic experiences, and creating a learner-centered environment are effective methods of engaging children in learning.

The study supports Hilke and Balling’s (1989) findings that information exchange occurs as spontaneous unsolicited sharing of exhibit experiences. The family teaching behaviours seen in the video tape and described in the transcriptions influence attitudes and supports Diamond’s (1986) thesis that the mutual exchange of information is an important aspect of the learning process in informal learning environments. Hence educators could plan more effective science lessons by encouraging the exchange of information in small collaborative groups.

Future Research

Reviewing video tapes of children’s behaviour in an informal learning setting such as a marine float and carefully analyzing transcriptions reveals rich information about the children’s thinking processes, their perceptions of fishing and fish behaviour, and how the social dynamics affects their thinking and learning. There is more to learning how to catch fish than meets the eye. What is it about the fishing activity that remains undisclosed by casual observation? Through the research, the fishing experience has become a source for generating new questions more than providing practical answers or maxims for teaching practice.

The "Catch of the Day" case study has yielded some specific examples to extend current research about learning in informal settings. However many questions remain for future research: How much of what the children learned on the float will be retained for the next fishing season? Will their curiosity about marine life (such as the hairy sea squirts) prompt them to browse through illustrated facts books if these were made available? Would the children apply what they have learned on the float to fishing off a boat in deeper waters? What other kinds of discovered problems do the children encounter in a marine setting, both on a float and in a boat fishing? More research is needed to determine if children who experience fishing become more environmentally sensitive, ecologically responsible, and willing to take positive action. What long term effect does learning how to fish ("I do...") have on a child's appreciation for and involvement in environmental issues ("...and I understand")?

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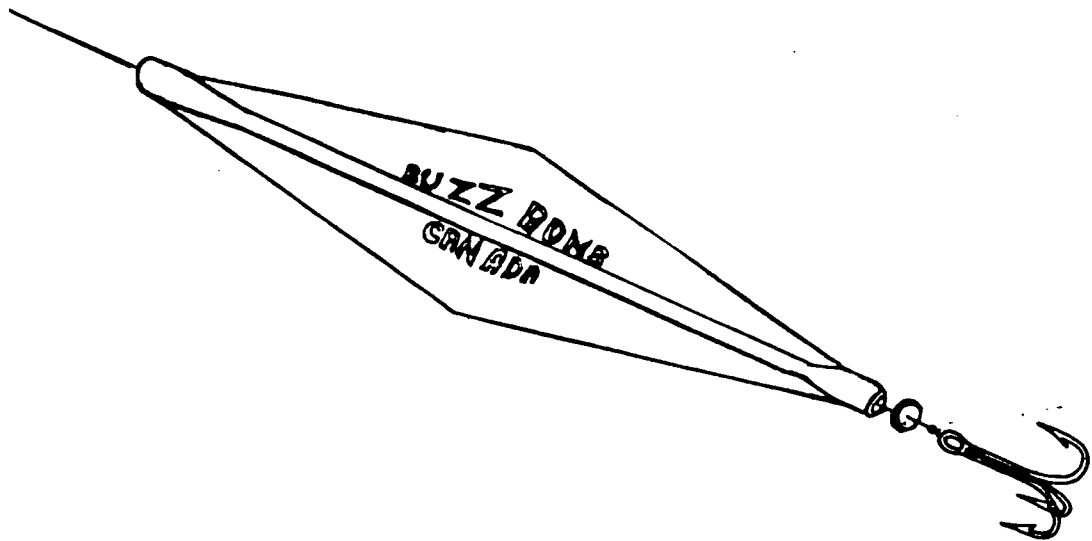
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APPENDIX A

Glossary Of Fishing Terms Used In The Study

buzz-bomb lure: a fishing lure designed to attract salmon by imitating a falling wounded fish such as herring. The lure's large blade has a hollow shaft that allows the lure to slide loosely on the fishing line. A large treble hook is knotted securely at the terminal end of the fishing line. The lure on the line is cast out with a jerk of the rod and retrieved by alternately pulling it quickly through the surface water creating a disturbance ("buzz") and then allowing it to fall ("wounded" action) while the fisher reels in the slack fishing line in order to pull the lure and repeat the action again.



casting: a method of still fishing where line is released freely from the reel, pulled by the weight of a terminal lure (such as a buzz-bomb), when the fishing rod is given a sharp jerk using wrist and forearm movements. The object is to hit a "target," a small area on the surface of the water beneath which fish could be waiting.

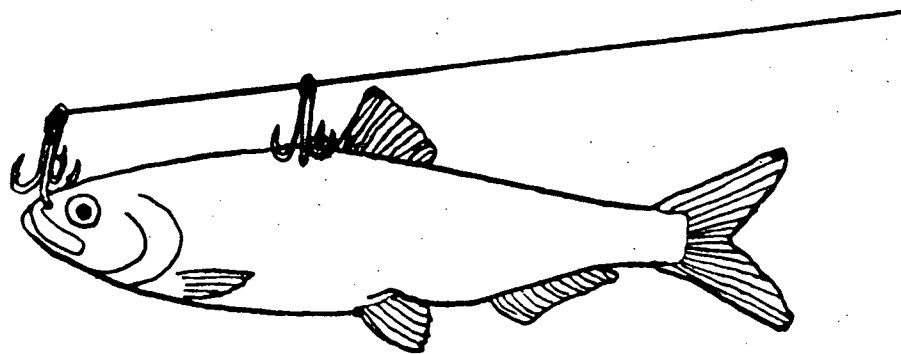
leader: a short piece of fishing line used between the main fishing line and the lure or hook that is designed to break under excessive strain thus preventing damage, breakage, and loss

of the main fishing line. Leaders are often made of lightweight monofilament fishing line for salmon hook-ups, or steel line to prevent large fish with sharp teeth from cutting the leader. Leaders often have a snap swivel fastener to attach to the main fishing line (a) so that damaged hooks and leaders can be removed quickly and a new leader attached, and (b) to help prevent fishing line twist as lures and baited hooks are drawn through the water.

mooching: a form of still fishing involving a flexible rod with a sensitive tip, a simple reel without any gears, a weighted line, and a baited hook. Nuttall (1980) states that the use of the word "mooching" probably arises from the original dictionary meaning which is

to amble, saunter, or wander aimlessly. This, of course, describes the basic technique which is to fish from a boat which is not under power. It is, in effect, a form of still fishing...The second meaning given by the dictionary is "to cadge or steal--to take without giving." This fits nicely in the context in which the word is used because that is precisely what the (fish) is trying to do down at the other end of the line (p.11)....In British Columbia the term "mooch" has become restricted. The meaning is often taken to cover little more than still fishing (p. 14).

salmon hook-up: two small treble hooks knotted onto a leader about 10 cm apart, used to hold a live herring through its snout and dorsal fin. Also called a "herring hook-up."



snag: when a hook gets caught on underwater objects such as the seaweed bottom, or the bodies of fish.

steak: a section of fish that results from making transverse cuts through the fish body.

still fishing: waiting for the fish to take the lowered baited hook while fishing from one spot on shore or from a boat not under power.

treble hook: a fishing hook with three barbed or barbless points.

APPENDIX B

Natural History Of Surfperch

Surfperch Species

- Shiner perch: *Cymatogaster aggregata*—from the Greek *cymos* (“foetus”) and *gaster* (“belly”), and the Latin *aggregata* (“crowded together”).

A silvery coloured fish (up to 15 cm) with three distinct vertical yellow bars on its sides.

- Striped seaperch: *Embiotoca lateralis*—from the Greek *embios* (“living”) and *tocos* (“bring forth”), and the Latin *lateralis* (referring to the lateral stripes).

A darker colored fish (up to 35 cm) with approximately 15 thin horizontal blue stripes alternating with gold.

- Pile perch: *Rhacochilus vacca*—from the Greek *racos* (“ragged”) and *cheilus* (“lip”), and from the Latin *vacca* (“cow”).

A large silver deep-bodied fish (up to 40 cm) with broad irregular black bands on its sides. The male is darker than the female.

Habitat

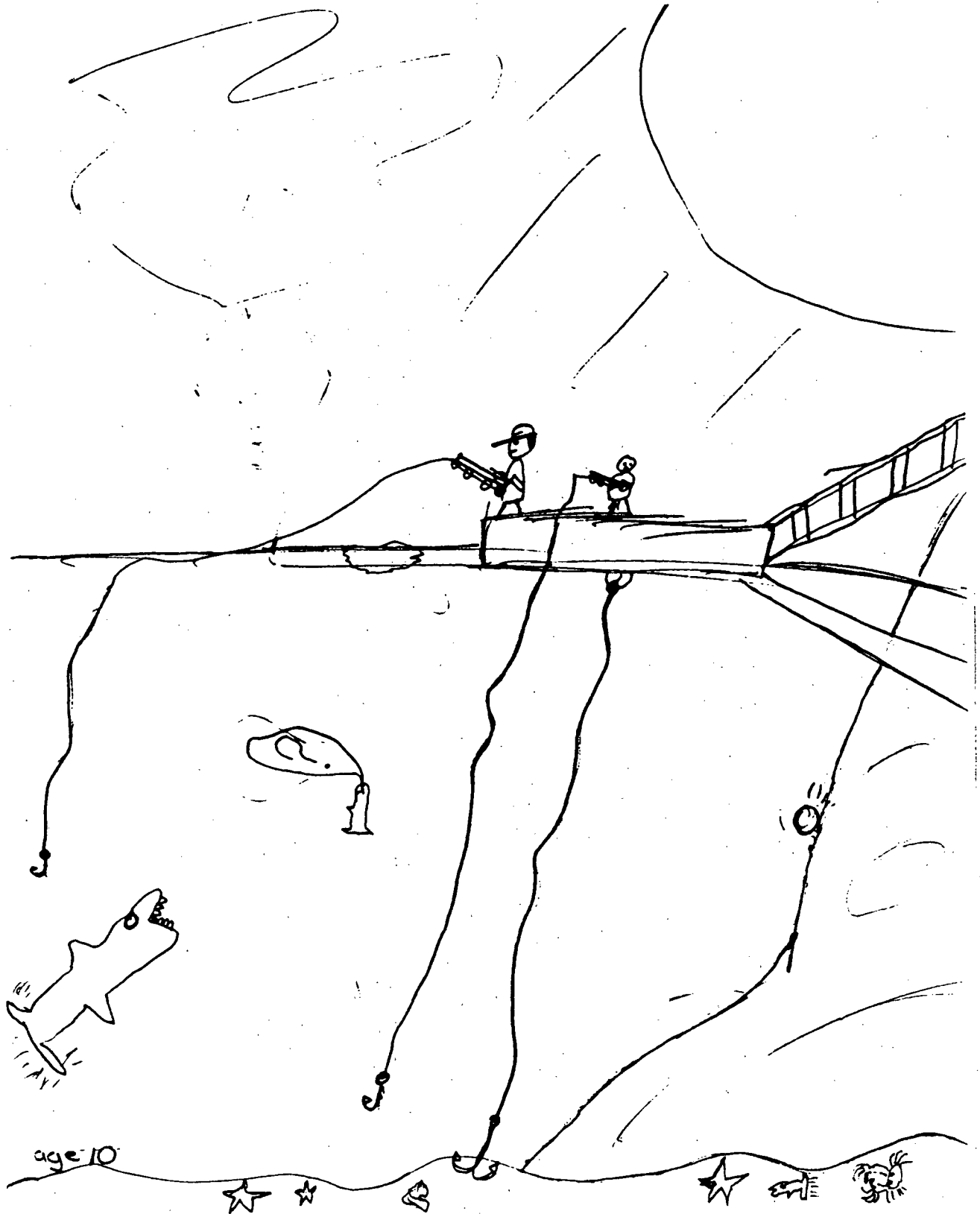
- Usually found in shallow coastal waters of the Pacific Northwest in summer, deeper (to 140 m) in winter.
- Often found around eelgrass beds during breeding season when mating and parturition occur. Commonly seen near piers, floats, pilings, and wharves which support the growth of mussels and kelp. Also common in bays and backwaters and in calm areas of the exposed coast.

Diet

- Surfperch are opportunistic microcarnivores feeding on small crustaceans, caprellid amphipods, polychaetes, and mussels. They also eat algae and zooplankton.

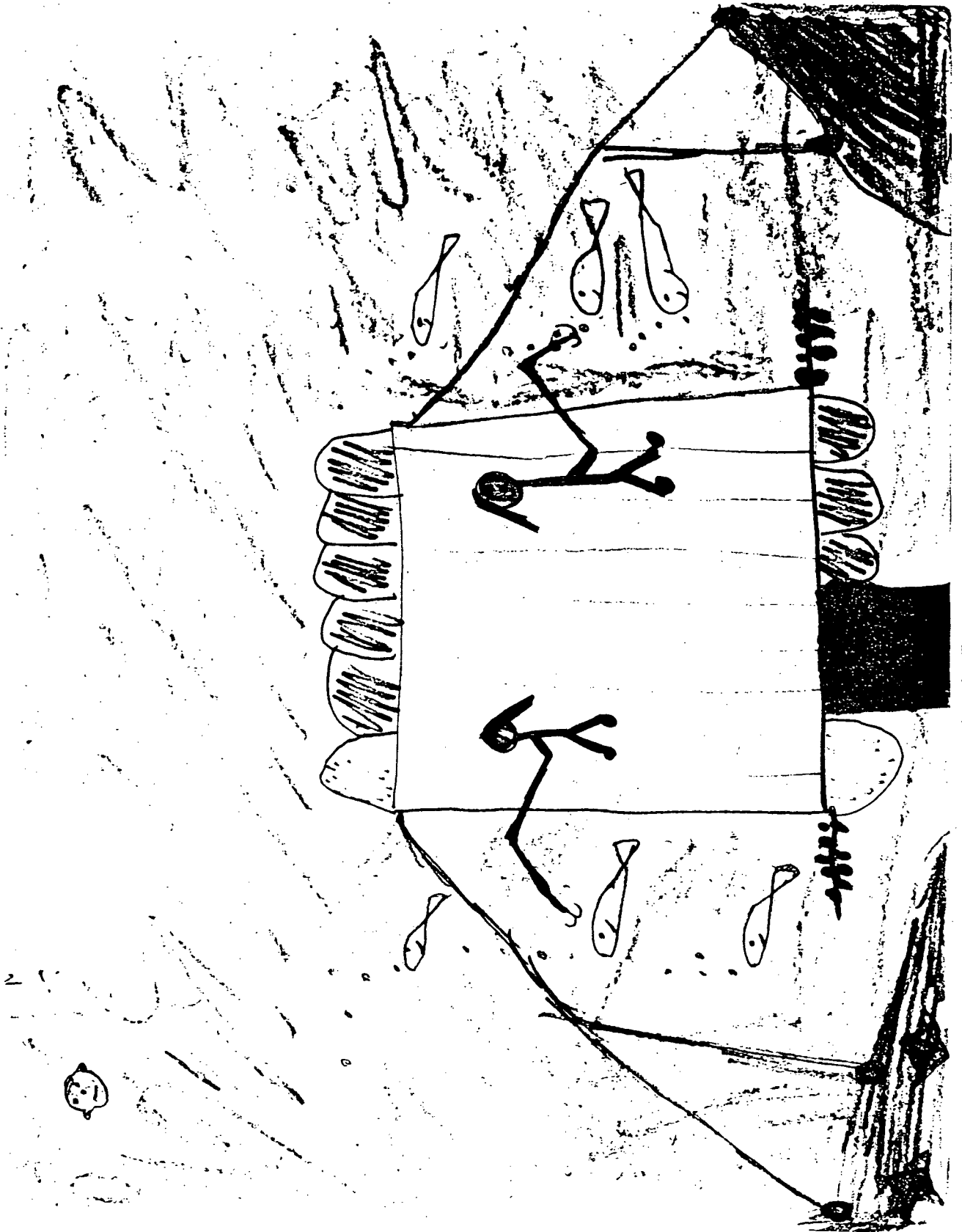
APPENDIX C

Children's Drawings: Drawing #1



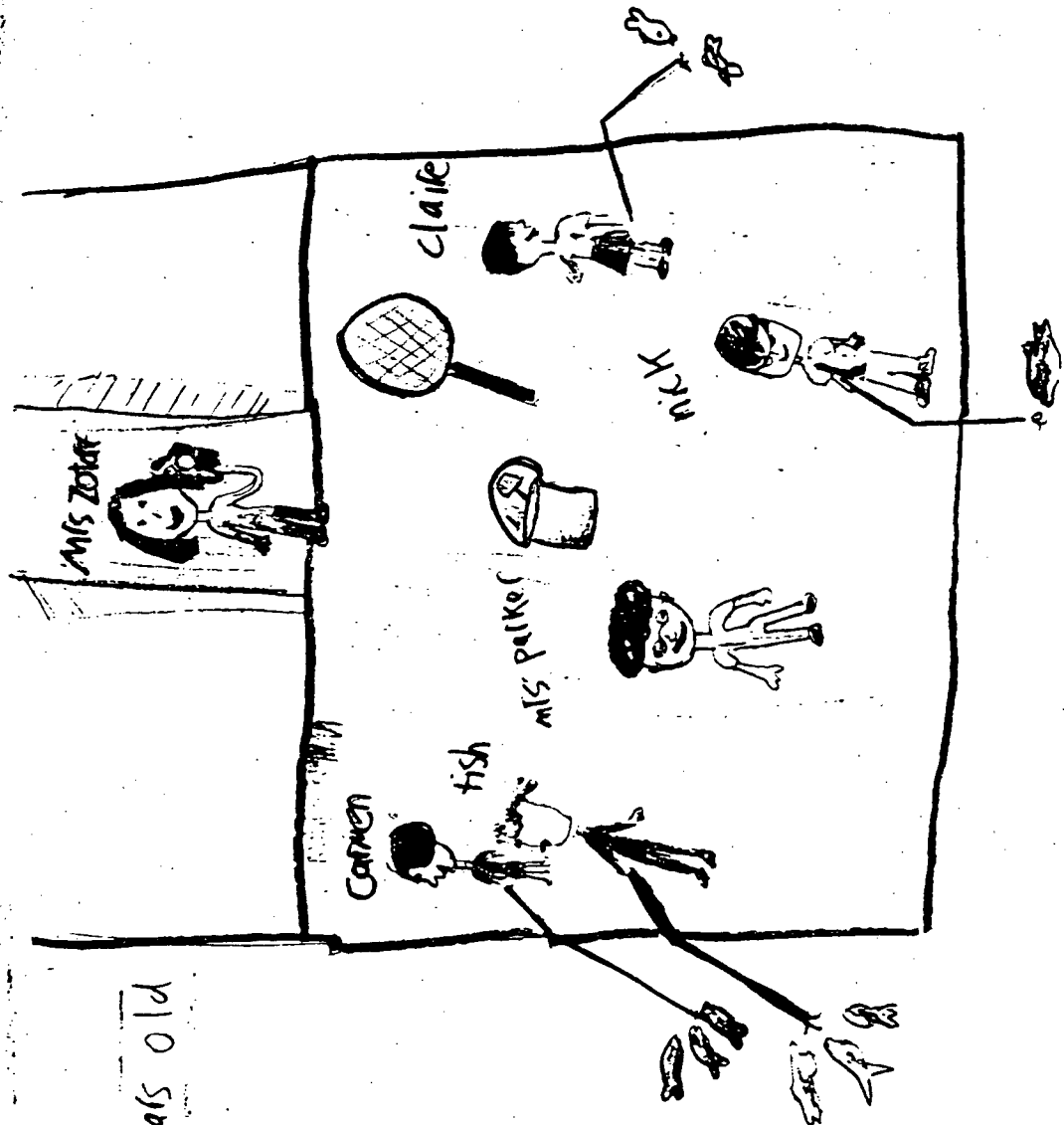
APPENDIX C

Children's Drawings: Drawing #2



APPENDIX C

Children's Drawings: Drawing #3



I'm 8 years old

APPENDIX D1

Transcription Of One Fishing Event (Event I)

Participants:

three children: KATE, JILL, MIKE

three adults: researcher as participant observer (RES)

colleague/parent operating videorecorder from ramp (PAT)

colleague on dock (KAY)

KATE: Probably because I let it go down. (Three children are fishing off the float.)

JILL: Oh darn. A little fish was by mine too you guys. A little one a baby one.

KATE: None of the little babies are over here.

JILL: There were lots of little babies.

KATE: I know. I saw them

JILL: My rod's all twisted. (She tries to untangle the line at the rod tip.)

KAY: Do you need some help with that Jean? (She calls from the dock.)

JILL: No, it's going. I got it. I pulled it up and there was a little baby fish.

KAY: Just watch when you swing that thing. (She calls from the dock to Mike.)

Be careful when you swing back. Be aware of who's behind you.

KATE: Oh, one of the fishes is at mine. A little one.

JILL: Just keep letting it. Just keep making it go down and he'll want it and grab it.

KATE: He wants it but he can't bite it.

JILL: That's because we have no bait.

KATE: I know. If it had bait. (She looks up at the dock to see if I've brought bait.)

MIKE: Is there any bait?

KAY: Yes, Mrs. Parker's bringing the bait.

KATE: I smell something like halibut right there.

MIKE: Man, I'd love to be fishing off that boat right now. (He indicates a passing boat.)

RES: Well, I have some herring. What have you got on your line? (I hurry down ramp.)

JILL: Fish!

KATE: I had a whole bunch of them. When I bring it up they're not there.

RES: Do you want to try some bait?

KATE: Ok.

RES: I have herring here, but I wonder what else perch eat?

KATE: I don't know.

RES: Have you ever tried to catch fish with herring before?

JILL: Can I put some bait on?

RES: Sure. Let's move this bucket here out of Mike's way. (He's using the long rod.)

There's herring in here. (I show the bag of herring.) Do you want a piece of that?

JILL: Yeah.

RES: Have you tried this before? Herring? (I removed a frozen herring from the bag.)

RES: Maybe Kate can try. Have you used these before?

KATE: Nope.

RES: This is herring.

JILL: Ooooh, it's frozen. Yes, you can put it on this. (She indicates her hook.)

MIKE: It's supposed to be frozen, Jill.

RES: Look at the size of it Mike. (I hold up a frozen herring.)

MIKE: Whoa!

RES: Do you think you could catch a fish with that? Or is it too big?

MIKE: You'll have to cut off a little bit.

RES: Cut it off? Do you want to cut it?

KATE: I'll just put my rod down and watch.

MIKE: Unless we're fishing for a huge fish.

JILL: It keeps coming up when I'm reeling it down. (She has difficulty with the reel.)

RES: For a salmon?

MIKE: It's hard. (He cuts frozen herring in half and takes the head.)

RES: It'll soon thaw.

JILL: Mrs. Parker, it keeps coming up when I'm trying to reel it down.

RES: Well, what can we do?

KATE: Head there. Can I just cut like a bit off, a little chunk?

RES: Sure.

JILL: Can I have a piece?

KATE: I'm going to try to cut off a little piece.

MIKE: That little piece. They'll just be nibbling.

KATE: You can cut some. I'm not that good. (She hands the knife to Jill.)

JILL: I'm having the tail.

RES: Oh. (I help to hold the herring as she cuts it.) Can you get it on your hook?

KATE: Ummm. (Kate shows the camera her herring "steak".)

PAT: I got a good close-up.

RES: That's a fish fillet! A herring fillet!

KAY: Oh, there's a seal coming to see!

JILL: Feed the seal. Can I throw this?

RES: This has bigger hooks in it. What about you Jill? Do you want a bigger hook?

JILL: André! He's André.

KATE: That'd probably be better. Maybe he'd like a piece of fish.

MIKE: Here. That'll work for now. (He baits Kate's hook with the herring steak.)

JILL: Oh, the bee's going to eat it.

MIKE: We'll probably get the seal.

KATE: I know. What if we get the seal and reel him up?

JILL: We won't.

KATE: We got it on but it's not very secure. (She refers to her herring baited hook.)

RES: Have you used these kind of hooks before Mike? These are herring hook-ups.
There's a loop on the end, see? Maybe you can put it on this one.

MIKE: Yeah, these'll do better. (Mike inspects them closely.)

KATE: I got a piece on but it's not very secure.

RES: Ok, here's the little loop for you for your hook. (I show him the loop on the end of the leader.)

MIKE: Oh, Ok.

RES: It's like a safety pin, isn't it?

MIKE: Oh, Ok.

RES: Then you can change your line real easy. Now what are you going to do with this?

KATE: I'm going to take that piece off.

MIKE: Want me to?

RES: How are you going to hook that on there so it's going to stay?

KATE: What if we get the seal?

JILL: Where's the seal?

RES: He'll come back. It's been here every day. It keeps popping its head out. It even goes underneath the float.

KATE: Have you ever seen him up close right there?

RES: I've seen him on the other side of the float here. You seem to have a way of keeping it on there.

MIKE: That should stay on. (He puts herring bait on Kate's herring hook-up using both hooks)

RES: All right. You're all set to go.

KATE: Thank you. Ummm, yummy Mike. Doesn't that look yummy?

MIKE: What? The head?

JILL: That piece is mine for the seal. I'm going to keep it right there for André. (She points to a chunk of herring on the edge of float.)

RES: So is your bait still on your line?

MIKE: I just don't want to hook the seal. (He gets ready to cast his line out.)

PAT: You won't. They're pretty clever.

MIKE: Yeah.

PAT: Am I in your way? Want me to back up for a minute?

MIKE: Sure. (He casts his line out.)

PAT: Good job!

RES: You've been practicing. (I comment to Mike about using the buzz-bomb.)

MIKE: Yeah.

RES: What do you think you might catch now, out there?

MIKE: I don't know.

RES: What do you think could be out there besides the seal?

MIKE: Um, I don't know. (He shrugs his shoulders.)

JILL: Could you hold this here? (She wanted me to hold her rod.)

RES: If I catch a fish, is it my fish?

JILL: Yeah.

RES: Do you see them down there?

MIKE: What?

JILL: A little one.

RES: How many can you count there?

KATE: I don't know. (A boat's wake causes the float to bounce up and down.)

JILL: Whoa! André must be having fun! (She named the seal after a movie character.)

RES: So, what's happening to the float?

JILL: Oh, oh. The fish is going to fall off it. (She refers to the herring she left on the edge of the float.)

MIKE: I got one, but it...

RES: What have you caught? (I speak to Mike.)

MIKE: I don't know. Maybe the bottom.

RES: How are you going to get it off? (Mike gets his buzz-bomb lure stuck on the sea bottom and I help him to get off.)

KATE: Those fish just got a big chunk out of my bait. They're little tiny ones. They're not...I think it was one of those um, pre...ummm.

PAT: Perch or shiners?

KATE: Yeah, perch.

JILL: Hey! I know what I can do. I see something I can catch. (She spies a piece of floating bull kelp that came up with the seaweed Mike was stuck on.)

PAT: Your brother? Whoa, look what Mike caught! (Mike brings up seaweed.)

RES: A feather boa or something.

MIKE: My bait?

RES: You might have just lost it on the seaweed bottom. Careful.

JILL: How did you catch that?

KATE: Hey mom, which way do you bring it up? Hey mom, um, Mrs. Parker, which way do you bring it up? I forgot.

RES: Oh, which way to bring it up? Oh. Those rods are really old.

KATE: See? They got a big chunk out of it.

RES: They're following it.

MIKE: Where is the bait? In the bag?

RES: Want some bait? Sure, it's in the bag here. Here's the knife.

MIKE: Well, unless the seal took it. Ah, here's a small piece.

RES: Oh, that one's lost its head, hasn't it?

MIKE: Yeah.

KATE: See, they all got a big chunk out of mine. It's missing. See? They won't hold on but they can eat it. Then see? There's a big chunk out of it.

RES: So, what are they doing?

KATE: They're just nibbling at it and then they won't hold on.

RES: Just one at a time, or?

KATE: Yeah, see? Look. See the hole?

MIKE: You've got to get deeper. You've got to get deeper then you can catch them.

KATE: They're all there.

RES: So, is it just one fish at a time trying to get it, or?

KATE: They're all there.

RES: So they're all there. They're all trying to get it at the same time?

KATE: Uh huh.

RES: So are they all trying to get it for themselves, or? How many do you see there?

KATE: I don't know. Maybe ten or fifteen.

RES: Ten or fifteen fish here. Jill look! There's ten or fifteen fish here. They're all trying to get it at the same time. Can you see it?

JILL: Yeah.

RES: So, do you think they're fighting with each other, or are they helping each other?

KATE: Maybe... I don't know, maybe they're fighting.

MIKE: Or helping, because...

KATE: Because maybe they could share it.

RES: So, they might all get it off. If they all work together, they might all get it off? Oh, there's a thought.

KATE: Because of that big chunk that's missing, they probably all got a bit. (The herring "steak" has flesh and skin intact, but frozen entrails are missing, leaving a visible hole.)

RES: Do you think one fish can get it off by itself?

KATE: Probably not.

RES: So, if they all cooperate together, that would be helpful?

KATE: Um hum.

RES: Ah! So this is cooperation!

KATE: I guess so.

RES: Ah! Ok!

RES: So, Jill... Oh! There's the seal! It just went right under the float. It saw the herring here. It went right underneath.

KATE: You might be able to feed the seal if he comes up again. We can just feed him if he comes out again.

JILL: I missed him! He stole my bait! I know it. He stole my bait!

RES: We saw the fish now, and they were all trying to take little bites.

KATE: Um hmm.

RES: So, how big do you think their mouth is on these little guys? Can you see their mouth?

KATE: I'll try a different spot.

RES: Have you kids ever tried any of these? Mussels?

MIKE: If someone wants to use mine, my rod. (He trades rods with Jill.)

RES: Have you ever tried to use mussels as bait?

MIKE: Yeah.

RES: Does that work?

MIKE: Yeah.

RES: How do you open it?

MIKE: Sometimes you can just step on them. (He demonstrates with his foot.)

RES: OK. Now what are you going to do?

MIKE: Open it.

RES: Oh, good!

MIKE: He's still alive still. (Mike picks gingerly at the crushed mussel to remove shell bits.)

KATE: I tried it on this side but they keep biting and they never get snagged.

RES: So, how do you get it out of there?

MIKE: Just scrape it out.

RES: Is there a certain part of the mussel that's really good for hooking?

MIKE: Some people say the worm is. But you have to hook it. That little worm thing.

(He refers to the mantle at the edge of the mussel.)

RES: That little worm thing? It looks like a worm, doesn't it, the edge?

Ok. Show me how you do it.

MIKE: What is that? Like string? (He notices the black cord fishing line and feels it curiously.)

RES: It's a black cord, yeah. It's a really old one. But it works really well. It's a different color than the other line. Do you think that might be a good idea or not?

MIKE: I don't know. Not really.

RES: I wonder.

MIKE: 'Cause they might see it.

RES: You're the first person that's noticed the color of the line. So, you think the fish might see it?

MIKE: Yeah.

RES: And if they see it, then what?

MIKE: And then they'll think it's something weird.

RES: They'll think it's a trap?

MIKE: Yeah.

RES: Hah!. That could be.

KATE: Maybe you want to get a shot of this mom. Something very different. See the difference? (She shows her bait to the camera.)

RES: Maybe we could do an experiment here to see who's going to catch the first fish: one with the black line or one with the clear line?

KATE: See? That's what they did. They've made a little hole.

RES: Oh, they've made a little hole in there, so you think the fish are just eating it away?

KATE: Um hmm.

RES: Are there a whole bunch of them?

KATE: I keep trying to get 'em out but they always move away.

RES: So, I guess you have to wait until they actually bite it.

KATE: Umhmm.

MIKE: You're supposed to try and snag them.

RES: Ah ha.

KATE: But then again fishing does take patience.

RES: Fishing does which?

KATE: You have to have patience.

RES: You have to have patience! Yes, you do!

JILL: I have two pieces on.

RES: Ok, she's trying with two pieces now on her hook. So, look at that. So, you've got two tails on. Is that better than two heads? Ha ha. Ok, so we've got two tails on a buzz-bomb lure and Kate you've got herring on a hook. So who's going to catch the first fish? How far down do you have to be to catch a fish?

KATE: I don't know. Maybe the bigger ones might be at the bottom.

RES: The bigger ones may be at the bottom. And the little ones would be?

KATE: Maybe more at the top?

RES: I wonder why that would be?

KATE: I don't know.

RES: Oh, I'll have to think about that one.

JILL: I'm going to get one out.

RES: Do you know how to get that out of there? (I point to the mussel she's opening.)

JILL: Oh, no.

RES: No? Have you done this before?

MIKE: Yeah.

RES: She knows how to do it? How are you going to get all that mussel slimy stuff on your hook?

KATE: I guess maybe they're smart fish 'cause they don't seem to get hooked.

PAT: Kate, let your line down more there.

JILL: Oooh, you can use this. I don't want to touch it. (She hands me the mussel tissue.)

KATE: I keep forgetting which way to reel it in.

RES: Want me to help you scrape it? How are you doing Mike?

MIKE: Good.

RES: Do you want a tool of some kind?

MIKE: Yeah, probably.

RES: I've got a...would the knife help you? Use it very carefully. It's sharp so...

MIKE: Yeah. (Mike uses a spoon on the end of the knife to scrape his mussel.)

JILL: Hey you! (She swats a wasp on the float.)

RES: So how many fish do you see Jill? See where Kate has her bait in the water? Where's your bait?

JILL: I don't know.

RES: Is it higher or lower?

JILL: Lower.

MIKE: There! (He is baiting his hook on the float.)

RES: Are there fish down there?

KATE: I don't know.

RES: So, you've got the hard part on there.

MIKE: There. (I watch Mike as he is on his knees baiting his hook.)

RES: OK, so you think that's going to catch a fish?

MIKE: Yeah, maybe a little one.

RES: So, we've got herring on two lines and mussels on another line.
What corner of the dock are you going to choose?

MIKE: This one because there are lots of little fish over there.

RES: That's a good strategy. Go where the fish are!

KATE: They're not going to snag on.

RES: They're not going to snag on?

JILL: When is André going to come?

RES: They're just biting away.

JILL: Whoa! Look at how much fish are on mine! Look at how much fish is on mine!

RES: Oh, now we've got a comparison. Mike has mussels. Kate, you've got herring.

JILL: Mrs. Parker, can you hold this?

PAT: Look at them all! Look at all the fish!

JILL: I like bees. Come on. I'm holding a bee again Mrs. Parker! Yeah I was. Come here. Come here. See? See? See? Ouch! He wants meat. I have no meat. Ah, I wish I did. Stupid bee!

KATE: There's a whole pile over here. See that fish has got away with some of the mussel and they're never gonna. See they got the mussel off an....

JILL: Hey you! You stop it! I have no meeeat! (She is talking to the wasps.)

KATE: One was caught but he got off. See? He was snagged by his lip but then it must have ripped through.

RES: Oh, you had him on there?

KATE: Yep.

JILL: How come everybody's fishing over here? (Mike has just come to join them.)

MIKE: 'Cause there's no room. Whoa! Whoa! Look at this! (He sees fish near his bait.)

RES: So which are they going for, the herring or the mussel?

KATE: They were all at the mussel. They took it all off and one got away with most of it.

MIKE: Oh. It's already off. Watch Jill, careful with that. (She has the long rod.)

KATE: They're all over there feasting. They're never gonna... They haven't seemed to find the hook to snag on.

RES: Now, I'm opening up this for him (to Pat) and we're going to try and get it on and make it stay. So, there's that foot again? That little hard part?

MIKE: Yeah.

RES: Stick it right in the middle of this (hook into foot). Whoops! It wants to rip, doesn't it? I'll try to get some more on here.

KATE: I'm going to try some more mussel because that's what attracted most of them, and one got snagged.

RES: Oh, so you're going to try mussel? (I then turn to Mike.) So, there's a big gob of mussel. Let's see if that works. So, look at all the mussels on this rope here. There's lots of them to pick. I'm going to find a big one.

JILL: Can I use this net?

RES: Yes.

KATE: The one you had on here was perfect.

RES: Let's see if we can find another one. Do you notice all the mussels on here? But take a look at the shoreline. Do you see any mussels at all?

KATE: No.

RES: I wonder why?

KATE: Maybe they like living underwater better.

RES: Underwater? Do you see any underwater over there?

KATE: Not really.

RES: Ah. This is puzzling. I wonder why they are there and not over there?

KATE: Maybe they like to live on...I don't know.

RES: Oh, we'll think about this one. Who has an idea? What do you think Mike? We have all these mussels here, and there's another rope here full of mussels. But there's none over there.

PAT: Can you see any meat there? (She said to Kate opening a mussel.)

KATE: I think I'll just stick the whole thing.

RES: I wonder why? Why would they be there?

MIKE: Maybe because it's deeper here.

RES: You think it's deeper here? Those ropes?

MIKE: No, those ropes have seaweed on them.

RES: What about these ropes here? It's a puzzle isn't it? I wonder.

JILL: I'm going to put some seaweed on my hook.

RES: Do you remember what we talked about in school about predators?

KATE: Umhmm.

RES: What eats mussels?

MIKE: Oh yeah, predators don't come this shallow.

KATE: Um, fish.

RES: Yeah.

JILL: André went somewhere else 'cause he didn't get any fishies.

RES: He was here all weekend. I think he was expecting some more kids to come back.

There's some on here. Do you want to try this one? I'll help you open another one.

KATE: Oh that's perfect.

JILL: A bee!

RES: You know what? When you stand very still they won't bother you. OK? But when you start to move around like that, then they start getting mad. That's when they start getting angry, so...

JILL: Oh, bee.

RES: Jill, if they bother you, the best thing you can do is just walk away up the ramp and say hi to Mrs. Brown and come back, ok? Because on a float like this if you are moving around too fast, you might just forget where you are.

JILL: Or when you scream you can OW! (Jill gets stung.)

MIKE: Did it sting you? (Mike comes over to her concerned.)

RES: Come put it in cold water. Come, put you hand in the water. Stick it right in.

MIKE: Let's see Jill.

RES: Now, were you swatting it?

JILL: Yeah.

RES: Oh, do you think it was a good idea to swat at it? How does it feel Jill?

PAT: So, what do you think would eat mussels?

KATE: Oh, they all do. They all came and grabbed it right off the line. So that's why I'm trying more. See? They're all after it. That one guy just got it all. He was snagged on it. I don't know. See? He just took the whole thing. See that?

PAT: Well, maybe...What would happen if you jerked it? While he was trying to get a good bite. Would anything happen if you jerked it?

KATE: Well, maybe I'd snag 'im. Would it?

PAT: How would you find out?

KATE: Try it? I'll go back and try it. Isn't that unusual they way they just took that all in a circle? I'll try to get this on and get it back in.

PAT: Careful. Are you hooked? (Kate hooks her shirt.)

KATE: Ummm.

RES: Oh. So, her first hooked fish here. (I unhook it from sweater.) I'll see if I can help you find a big mussel. (Kate holds up her herring "steak" with a hole in it.)

PAT: Isn't that neat? I wonder why they did that?

KATE: Maybe it's the better part of it?

RES: All the bait you need is right here. (I show mussels stuck on the edge of the float.)

KATE: I'm going to take that thing because I'm going to try it again. I'm going to jerk it when the fish bites, and maybe it'll snag 'em.

RES: Ok, so you mean you're going to try mussels, or are you going to try herring?

KATE: I'm going to have some more mussels.

RES: More mussels? Ok. You're very brave (to Jill.)

JILL: I'm going to get it open.

RES: Can you crunch it with your shoe?

JILL: With a spoon?

RES: Spoon is over here. He's going for the herring. (A wasp buzzes around her.)
That's what it wants. Oh look, can you see there in the water? Do you still have
enough bait on your line?

MIKE: Mrs. Parker, I've got a bunch of them over here. I don't know. I haven't
checked. I'll check it.

PAT: Ha ha. Ah! What happened to your bait?

MIKE: I'll try to snag 'em.

JILL: I'm gonna catch a fish for sure today. (She is cutting herring and swatting wasps.)

RES: They're interested. There's quite a few down there.

JILL: If I swat him with the spoon will he die?

RES: Well, do you really want to play with the wasps, or do you want to fish?

JILL: I want to fish.

RES: Good idea. That's what we're here for.

JILL: But his won't crack. (She shows a mussel.)

RES: She was very brave there. She didn't cry when the bee stung her. Here, try that.

PAT: Look at that big one down there! It's huge!

RES: Oh yes, look at them! There's several different kinds of perch down here. There's
pile perch, shiner perch, and striped sea perch.

PAT: They're huge! They're big ones.

MIKE: I wonder if the fish stole my bait.

RES: I've seen wolf eels under here and ling cod.

JILL: He stole my big one.

PAT: He's right here. Do you have bait on your hook? Because he's right down there.
He's a big one.

RES: Ok, that's a big hook for mussels though. You know what? If you want to use
another rod, there's a couple of little ones up there. The same rods as these ones.
Jean wants to have mussels on here as well. (She already has herring bait on.)
Do you want to do it?

JILL: No.

RES: Ok, I'll put in on. How's your finger now? Ok there you go. So now you've got
two kinds of bait on there. What do you think you will catch now with two kinds?

JILL: I don't know.

RES: Let's try and find out.

JILL: Or else I could use two lines.

RES: Ok, have you got a picture of that? Jean has got two kinds of bait on here. Do you
want to go over here? All right. (She has one herring tail and a glob of mussel on
the hook.)

JILL: This is a big rod.

KATE: I have some mussels on, so probably over there.

MIKE: Oh, look at that big one!

PAT: Well, they're certainly interested in that.

MIKE: Mrs. Parker! There's big ones over here.

RES: Mussels? Just rip them off because they're big ones.

RES: I wonder why? (I ask looking at the hole in Kate's herring steak) What do you
think pile perch eat?

KATE: Um. I don't know.

RES: Well, I just pulled the rope up here. Do you see the pile perch along the shore
there?

KATE: Um, no.

RES: I wonder what they could be eating on here?

KATE: Maybe mussels.

RES: Maybe mussels. Do you see herring swimming underneath the float?

JILL: Can you hold this just for a minute so that I can see my bait. Oh no! They stole it! those bad fishies. (She brings up line by hand on the nine foot rod and inspects the bare buzz-bomb lure)

RES: So, what are you going to do now?

JILL: I'm going to get some more. (She heads for the bag of herring in the bucket.)

RES: They stole it? So, do you think those fish are smart enough to steal things?

JILL: Yeah.

RES: What do you think Mike? Do you think fish are smart?

MIKE: I don't know.

RES: What do you have to do to catch a fish?

JILL: I'm going to use the head. No, I'm going to use two pieces. The head and, actually, three, maybe I'll have the head, the tail, and the middle.

RES: On the same line here?

JILL: Yep. (She inspects the whole herring closely.)

RES: Ok. Let's see how you're going to do that.

JILL: Ah, it's hard to bend my finger. See look? I have three.

RES: You have three hooks.

JILL: See! Look! I have three hooks. (She cuts the herring into three pieces, one for each hook.)

RES: So, what are you going to do with three hooks?

JILL: Head, middle, tail.

RES: The head, the middle, and the tail on the three hooks?

JILL: I'm gonna see if that'll work. I think this will cut more fish. (She chooses one of the two knives and cuts the herring) First the head...and then the tail! Now what will happen?

RES: So, what's going to happen if you put all three pieces on?

JILL: I don't know. Ask the fishies. I bet you the fishies know what's going to happen.

RES: Look at that. Doesn't that look tasty? Isn't that a tasty morsel?

MIKE: Um yeah. Lucky for them. (I hand mussel on the hook to Mike.)

JILL: This is gonna be really tasty, I know so they can chew as much as they want.

RES: So I'm interested in what you're doing here. You've got three pieces of herring and you've got three hooks

JILL: I'm going to fish.

RES: Even the wasps are interested!

JILL: OW! (A wasp lands on her finger.)

RES: Don't swat them remember, just, just move slowly and they won't bother you.

JILL: Where's my third one? Oh oh, this hook has two. (She wants to have each piece on a separate hook) That's why I can't find the third one. This looks good.

MIKE: I felt a tug. You guys, I got one! I got one!

JILL: Is it big?

KATE: Because I felt it. I saw it going down.

JILL: Do you still have it?

MIKE: It went away.

JILL: I smell like salmon.

PAT: Get down there and catch it again. What were you using for bait Mike?

MIKE: A big gob of...yeah, but I got one!

PAT: Of mussel or herring?

MIKE: This is one of the best spots!

RES: What will you do to make sure that the fish stays on? What strategy could you use?

MIKE: I felt the rod and...

RES: Remember how I put the mussel on? Maybe Mike you can tell Kate. Can you help her put some on her line.

KATE: I got it on before.

PAT: Look at Jill. (Jill has three bait pieces on the buzz-bomb lure.)

KATE: If I can get it. It's hard. I'll try it again, ahhh!

RES: It's so slippery. She's trying to hook the foot. (I comment for the camera.)

KATE: It might be easier just to put it on the dock.

KATE: Ooooh, that's the foot. That's where I was trying to hook it on, that part right there. See it? Ha! (Kate shows the camera the foot.)

MIKE: Mrs. Parker, could you help me hook it on, because the way you hooked it on...

RES: Ok, I'll show you.

KATE: That's not the foot.

RES: Now with this piece here, I just take my thumbnail and scrape it off just like that and get it clean. It's really hard on your fingernails. Now we have to find the tough part. Oh, there it is.

MIKE: Yeah, but how do you like get it on so it's..?

RES: You have to get it right through the middle of that part.

JILL: Mrs. Parker, they like the eyes more!

RES: Hang on a sec Jean, we're just hooking on a nice fat mussel. Ok, now wrap the rest around it so the hook is hiding. So, they like the eyes more?

KATE: I'll just try it like that. It's covered.

PAT: Is it on OK?

KATE: Well I'll try it. Um.

MIKE: Got one?

KATE: No, my thing is very mixed up here.

RES: Well, let's see. I wonder how that happened? There you go. (Her line was tangled.)

JILL: I'm going to cast. It looks like I could cast here. (She has the nine foot rod.)

RES: You're going to cast? You know what, if you try to cast your bait will all fall off.

JILL: I'm not going to cast, I'm just going to let it fall down.

RES: Do you want to drop it down here?

JILL: Can I fish over there?

RES: It's pretty shallow over there.

JILL: Wow a big starfish. There's a starfish.

RES: Well, are you going to catch fish, or starfish?

JILL: Fish.

RES: How about putting your line down there and see what's down there? It's so deep, you can't see the bottom.

MIKE: Mrs. Parker, I got one! (Mike catches a striped sea perch.)

RES: Oh, wow it's big!

PAT: Oh, is it ever!

MIKE: It's a rainbow I think.

RES: No, this is a striped sea perch. Yeah, it looks like rainbow colors doesn't it?

KATE: Oh, don't kill him.

MIKE: I'm going to keep him.

PAT: What kind is it?

RES: Whoops! It doesn't want to stay still for us. This is a striped sea perch. Do you see how it's got bluish-purplish stripes? Beautiful aren't they?

KATE: Let's put him down.

RES: We could put it in the bucket and then take him off?

KATE: I want to let him live. Whoops! I'm not watching my line.

RES: Well, we need to get him off there. How are you going to get it off?

KATE: Oh, I don't know.

RES: So, what kind of bait were you using Mike?

MIKE: Mussels.

RES: Mussels? So, do you think mussels work better than herring?

MIKE: Kinda. Well, it depends on what you're fishing for.

RES: What's your secret in catching this one. What did you have to do to get it on your line?

MIKE: I just dropped it down.

RES: You just dropped it down. And then what did you do?

MIKE: I usually just reeled it up.

KATE: You see, one fish stole it. Well, Mike got the first fish of the day.

JILL: I thought we were going to keep him until we go home.

RES: You want to keep him in here? Do you think the fish would be happy in here?

MIKE: No.

RES: No. Probably not.

JILL: We could keep him in the fish tank Mike.

RES: How are we going to get that hook out of there?

JILL: I'll show you. I see some pliers.

KATE: Are we gonna let him go?

RES: What are you going to do now? (Mike lifts the fish out of the bucket by the line.)

KATE: Are we going to let him go? Or are we gonna keep him?

JILL: We can keep him in a fish tank. We can put salt water in a fish tank.

MIKE: Are those like spikes? (He points to the perch's dorsal spines.)

RES: Yes, those are spines. Now how are you going to get that off there?

JILL: Mike, we can put salt water in our fish tank and keep him in there. But he'll die in this water.

RES: Yes, it's really in there isn't it. Do you want some help?

KATE: Don't just pull it.

MIKE: Yeah, it's hard. (He wasn't sure how to get hook out.)

RES: I'm going to hold it just gently this way, and then sometimes I use a pair of pliers.

If you get the shank of the hook very gently, there, just twist it up a bit.

MIKE: Did you break it? (He saw the pliers break the shank off the hook.)

RES: I broke the hook. Ha ha!

KATE: So the hook is still in him.

RES: You know what? It will rust out anyway. These hooks don't last very long.

KATE: Will it kill him or...?

RES: No, it won't because in the salt water...what happens to iron in salt water?

Remember we did that steel wool experiment in school? What happened after a few days?

KATE: It rusted and it grew all this stuff on it. (She refers to salt crystals on the beaker.)

RES: It disintegrated?

MIKE: Yeah.

RES: So, look at the mouth on this fish. Look at how tiny it is. Take a look at the size of the mouth.

RES: Do you think it could actually catch herring?

MIKE: Nope

RES: Why not?

MIKE: 'Cause it's mouth is too small.

RES: So, what do you think it might eat?

ALL: Mussels!

RES: Yeah! Should we put it back, or does the fisherman want to put it back? You want to put it back in the water?

JILL: Can I hold him before he goes back? Can I hold him before he goes back Mike?

MIKE: He's still alive. (He watches the perch disappear beneath the float.)

KATE: Um hm. First catch of the day.

JILL: Hey, one of my other ones are gone!

KATE: I'm gonna load this hook up with mussels so I could catch one.

RES: Oh, so you mean something's eating your bait while we're not looking?

KATE: Let's get the big sucker!

MIKE: So Jill, something big's been eating them.

JILL: I'm going to fish over here. (She moves to the edge where Mike caught his fish.)

RES: Are you going to catch one of those fish that Mike caught?

MIKE: I caught it with the black line too! So...

RES: Oh, isn't that interesting. Now what kind of theory do you have?

MIKE: So, maybe both of them work.

RES: So, maybe both kinds of line work?

MIKE: Yeah.

RES: So, maybe You think the fish couldn't see your line because it was black?

MIKE: Um, yeah. Maybe.

JILL: Mike, can I use that rod after you?

MIKE: Or maybe 'cause um, the hook part was dark.

RES: Oh. It's hard to tell. Now we'll have to get something to put on the end of this.

JILL: Now, I'm going to leave it here and let another fishy get it. (She puts rod on float.)

MIKE: I wouldn't Jill.

JILL: Yeah, I'm going to let the fishy take my bait.

RES: There's another rope over here Mike. Do you want to see if there's mussels here?

KATE: That mussel's gone. (She shows an empty shell.)

JILL: Yikes, the bee!

RES: Remember what we said about bees, right? Just move slowly?

MIKE: Oh look, it just squirted all by itself! They're alive!

PAT: Is it a plant or an animal?

MIKE: It looks like a....with hair. (He points to a hairy sea squirt on the rope.)

RES: It might be a...I can't remember. I'll have to look that one up in my book.

JILL: Ooooh! (Children watch the sea squirts squirting on rope, and start laughing.)

KATE: What is that? Let's pop it.

MIKE: They look like strawberries, ha ha.

RES: So, we'll have to remember that description when we look them up. Now what do you think the pile perch might be eating on this rope?

KATE: Maybe that.

RES: They seem to hang around this rope a lot.

MIKE: Maybe some of the stuff.

RES: The stuff that's on here. (I indicate the encrusted ropes.)

KATE: What's that orange thing?

JILL: A starfish!

KATE: Well, it's definitely,...I don't know. It's definitely squished.

JILL: I'm going to cast with the starfish.

RES: If you throw things off the edge there, do you think the fish might be interested?

JILL: I'm going to cast with the starfish.

RES: You're going to cast with the starfish?

JILL: No, nothing will bite it.

RES: So, what do you think is on there that might be good to eat?

KATE: Yummy, yummy. (She holds mussel to the camera.)

RES: Do you think the starfish was eating the mussels on that rope?

KATE: Oooh, I can't get it off. Mrs. Parker, I can't get it out of the shell.

RES: Ok, here's one. I got it all out, and there's that little piece.

JILL: I'm going to cast with this. (She shows starfish to camera.)

RES: So you're going to cast with this. So you think something will eat this? Do you think it would be tasty for something in the ocean? Ok.

JILL: Maybe the seal.

RES: The seal, maybe. You could try. Maybe the seal will come back.

JILL: I hope something would eat it.

RES: So how are you doing there Mike? Is it staying on this time?

MIKE: I'm just putting it on.

JILL: What should I do with this tail?

KATE: My bait'll fall off, or whatever.

JILL: Can I step on that bee? I bet it'll die. Can I? Can I step on that bee? It's down.

KATE: I put it more down there. Is that where you caught it? Was it really low? (She has moved to the spot on the float where Mike caught his fish.)

MIKE: Yeah, snag it.

PAT: There's whole pile right at it.

KATE: Yeah, I know. Those little guys are so annoying.

MIKE: Yeah, I know. They just pick at it.

RES: Look at them following it up. Ah, you're teasing them. Ha ha.

MIKE: That guy probably had it. (Mike catches a shiner perch.)

KATE: He caught another fish! It must be the black line!

RES: How about that! Well that line is so old. I guess I shouldn't throw it away. This is a different kind of perch. Do you remember the name of the one you caught?

MIKE: A rainbow.

RES: A striped sea perch. But this one is a shiner perch because it's got three yellow stripes. One, two, three. A shiner, and they shine when they move around a lot.

MIKE: Yeah. That's a shiner.

RES: How are you going to get this one off this time?

MIKE: Oh, this one's easier. I'll hold the jaws.

JILL: Can I let him go? Can I let him go this time?

MIKE: Yep. Here.

KATE: Isn't he cute?

RES: It looks like you have a special way of holding that fish too. Very gently, right.

KATE: Can I try a black line Mike? I'm going to try a black line.

MIKE: Here Jill, do you want to let him go?

JILL: Yep.

MIKE: Hurry!

JILL: Ah! (She drops the shiner to the float and picks it up again.)

MIKE: Don't worry, don't worry.

KATE: Just pick it up with both hands.

RES: Do you want to show him to the camera?

JILL: See camera?

RES: What's that called now Jill? A shiner perch?

MIKE: Hurry, just drop him.

KATE: I'm never gonna...I'm going to try a black line next.

JILL: I'm gonna cast over that way. (She picks up the small mooching rod and moves to Mike's spot on the float.)

MIKE: Cast?

KATE: You're not going to cast.

RES: You're not going to cast, you're just going to mooch. Just drop it down over there.

MIKE: I got one! (Mike catches a pile perch this time.)

KATE: What? Again?

RES: But he's not using a black line. Oh, now you've got a pile perch. That one's a pile perch. See how it's different from the other two? They all belong in the same family group.

JILL: Whenever I let this down see, it comes back up.

MIKE: Sometimes it's easy if you just go, but not hard, not like...

JILL: I'll let it go.

RES: If you were going to kill them. You know what, if you were going to kill them, but take it very gently like this. You see how I hold it like that?

MIKE: I hooked him in two spots! I just don't want him to wiggle.

RES: Where's the pliers? There's the pliers right here.

JILL: Oh, it's going to get stuck in him though.

MIKE: I got him in two spots.

JILL: It's going to get stuck.

MIKE: There.

RES: See how the pliers help you that way you don't get your fingers stuck.

MIKE: Yeah.

KATE: We've got three fish caught by the same person.

RES: When they're near the ocean too long see what happened to my pliers? That's what happens to the fish hooks. So, this one's a pile perch. You see the black stripes? It's probably a male.

JILL: I want to let him go. I'll let him go.

RES: That was such a strong bite, look at what happened to your hook here. What happened to the hook? It's totally bent. Look at that. Wow! That's a strong fish!

KATE: What is it with Mike? He's just....but I didn't even catch a fish!

RES: But this rod you were using didn't have a black line on it.

MIKE: Yeah, so it's not the black line.

RES: So, it's not the black line. So what other..?

KATE: Maybe it's just a streak of luck.

MIKE: Yeah, maybe it's just luck.

RES: Maybe it's just his fishing skills.

MIKE: Maybe it's just where I dropped it.

KATE: Maybe it's the bait.

RES: Maybe it's the bait. Yeah, lots of reasons why some fishing is good.

JILL: Somebody help me let this down.

MIKE: Here, I'll show you.

RES: You're pulling it out to let it down are you? So, what have you learned about fish behaviour here today?

MIKE: They like to be by these ropes.

PAT: Oh, look at the big one Jill.

JILL: Can you tell me when it yanks?

PAT: You'll feel it.

RES: So, you saw all the tiny shiner perch. They looked like they were fighting over it? What have you decided they were doing?

MIKE: Maybe they were helping each other.

RES: Maybe they were helping each other? How could you tell?

MIKE: Yeah. They were all taking little bites out of it.

KATE: Let's just see what this does. Maybe I'll try Mike's spot.

MIKE: Yeah, maybe it's the spot.

KATE: Yeah, maybe.

RES: Maybe it's the good fishing spot. Ah ha.

MIKE: That's the shady side. Maybe that's what it is.

KATE: Maybe. I never caught any.

JILL: Oh, that's a nice fish. Lookit, right there.

MIKE: You have to jig it up and down. That's how I caught them.

RES: So, you jig for fish sometimes do you?

MIKE: Yeah. Sometimes I just snag it up. (He motions with his arms.)

RES: So, the fish go for it when you jig it up and down?

MIKE: Yeah. (Mike helps Kate with her reel and line.)

RES: I wonder why they go for it when you jig it up and down?

MIKE: So they think it's alive.

RES: Oh, so they think it's alive. I see. That's a good strategy. So you think fish would rather go for stuff that looks like it's alive than just sitting there?

MIKE: Yeah, cause like, not really. Are you reeling it up?

KATE: Yeah, 'cause there's nothing there.

RES: I have one more bit of bait here.

MIKE: Kate can have it.

KATE: I'll have it 'cause I haven't caught any yet.

RES: Let's get it on in a hurry so you can catch one more fish.

JILL: Me too.

RES: Ha, some days I've gone fishing and I haven't got anything but everyone else has, and other days I've caught all the fish and no one else has got any. That's the way fishing is. Do you think the fish really care whose line it is? Give it a try.

KATE: OK.

MIKE: Oh, there's a big one right there.

KATE: Where? Ok, let's reel it down. Let it down, down, down. (She pulls out line from her reel as Mike watches over her shoulder.)

RES: How are you doing there Jill?

PAT: There's a lot around there.

RES: There's a big one there too. Look. See it's interested. It's sure interested in yours.

MIKE: Catch it Kate! There's lots of them.

PAT: There's one there. It's after something. They're coming for it.

MIKE: Pull it up! Pull it up!

PAT: Not too fast. Slow down, slow down. Let it down more. Wait there Kate. Gentle.

RES: Oh, look at the size of them!

MIKE: Down a bit more!

KATE: I got something! I felt something. I don't think I have any bait.

PAT: You pulled it out of his mouth. Drop it again. now wait. He's coming back

KATE: I have to bring it up because I think I lost my bait.

JILL: Is André here yet? No, André didn't come yet.

PAT: Is your bait still on?

KATE: No, I don't think so.

RES: Well, I have another bit here.

KATE: I lost my bait.

JILL: What is that? (Waves bounce the float again.)

RES: What's happening to the float? Why is it doing that?

MIKE: A boat just went by.

RES: A boat?

KATE: Yeah, that big fast one.

RES: Oh, a crew boat. Here we go. It's a good thing we had our jackets on.

KATE: Yeah.

JILL: I wouldn't like to fall in that! (She points to the ocean.)

RES: You should catch a fish with this for sure.

KATE: I swear I felt him tugging at it.

PAT: He was. I saw him.

RES: Well, that one's on pretty tight Kate. You should catch a fish with that.

KATE: Oh shoot! It's all tangled there! (She starts to tug at the black cord in her reel.)

MIKE: Here Kate. (Mike helps her untangle the black line in her reel.)

RES: I'll help you get it. Let's get some light on it. So we have a tangled mess. That's never happened before. (I help Mike pull out line from the reel to untangle it.)

KATE: I don't know.

RES: We have a problem here. What are we going to do about this problem?

MIKE: Oh, it's fixed.

RES: Is it? Maybe.

JILL: Hey, this is a big one. (She holds a mussel.)

KATE: I bet if you put double time mussel on it you'd surely catch one.

RES: Oh yeah. You mean twice as many mussels mean you'll be twice as successful?

Ah look. This is coming off. How are you doing there?

KATE: That's good.

PAT: Ok, let it down Kate.

JILL: Can you help me get this off?

PAT: And there's some big ones coming right for it.

MIKE: Whoa, whoa, stay there! Stay there. (Mike instructs Kate.)

KATE: Which way is backwards?

MIKE: Actually, reel it up a bit. Reel up, reel up. There's a big one right here.

RES: It's hard to find the best part, isn't it?

KATE: There he is. I saw him.

MIKE: Go over there some more. There, stay there. That's good.

JILL: Is André over there?

KATE: Oh, I got it! I got something! (Kate snags a shiner perch on the side of its body.)

MIKE: Yeah, you got it!

RES: So, you remember what kind of fish this one is?

MIKE: Oh, you just snagged it.

RES: How are you going to get it off now?

PAT: Bring it in. What kind is this?

KATE: The kind that Mike had.

MIKE: That's a three,... a shiner.

RES: A shiner, yeah with three yellow stripes.

MIKE: I was going to say a shriner. Ha ha.

RES: What was the secret to getting that fish?

KATE: Hold it. Ah, he's breathing. It's hooked just right there where his gill is.

MIKE: Ah. We already got it out. Do you want to put him back?

KATE: Here you go. (She dumps the fish back into the water.)

RES: One last gob here. At least you're going home with a good fish. So when we hooked that, remember we put it right through this piece. There. Try that.

KATE: Ok.

RES: Look at that, wow!

MIKE: Oh, that'll. ..oh, that'll catch more!

KATE: Show this to the camera. A big gob of that.

RES: And you're going to find the seal.

KATE: She may not have caught a fish, but she got to feed a seal.

JILL: Somebody stole my bait!

RES: Your bait's gone? I have another one right here Jill.

JILL: A nice big one?

RES: This will be your last one.

MIKE: Whoa, whoa, whoa! (He watches her line go down.)

PAT: There's some big ones Kate. Bide your time.

MIKE: Pull, pull, pull!

RES: Oh, it's interested. Look! Wait until you feel it tug.

PAT: Look at the size of him!

MIKE: They're huge. The big fish are under the dock. Mrs. Parker, most of the big ones are under the dock.

RES: Oh, so you think the big fish are under the dock? Well, why would they want to be there?

MIKE: Maybe there's like food at the top of the dock.

RES: Oh yeah, I see.

MIKE: Could be mussels or something.

RES: What about predators? Could there be predators there?

MIKE: Probably not.

KATE: I don't know if my bait's still there. I'll check and see.

MIKE: It's not on there anymore.

PAT: The big one got it. Oh! Jill got one too. Yay! Bring it up!

JILL: He's not on. (Jill catches striped sea perch.)

RES: So do you remember what kind this one's called? It looked like a rainbow?

MIKE: Oh yeah, a striped...

RES: A striped sea perch. Look at that. Isn't it beautiful? You hooked it so gently.

Look at that. This will be easy to get out. Hold it gently. There you go. Do you want to let him go? Isn't he beautiful? (She drops the wriggling fish on the deck and picks it up again.)

MIKE: Oh, it looks like it's going to have babies or something.

RES: Do you know that all these perch give birth to live babies?

JILL: I still have bait?

PAT: Good job. You all got something now.

RES: That shows you how tough that piece is. It was still on the hook.

PAT: That was great. You guys caught fish today!

KATE: I caught a fish.

APPENDIX D2

Transcription of Event II: Group interview

- RES: You had a problem there didn't you Jill, trying to get your line to go down.
- JILL: But it kept coming up.
- RES: I noticed Mike that you were helping a lot. You were helping Kate bait her line. So what happened here Mike?
- MIKE: I got the bottom.
- RES: Did you have some ideas to get it off?
- MIKE: Yeah, yank it. (He motions.)
- RES: You had lots of different ideas for catching fish didn't you Jill?
- RES: Look at his cast here.
- MIKE: It's too big of a rod.
- RES: Yes, it is too big for a little space. You were very careful with other kids there.
- PAT: Is that the rod you used to catch the fish? (meaning the long rod.)
- MIKE: No, the old rod with the black line. I caught one this big. (He holds hands up about a foot apart). And then I caught another one this big. (He makes the same motion.)
- RES: You were saying Mike that the inside of the mussel looks like a worm. It does look like a worm doesn't it?
- MIKE: Yeah. It's what I caught the fish with. You have to try and snag them.
- RES: There's good advice. So you took that spoon there as a tool and decided to scrape out mussel?
- MIKE: Yeah.
- RES: You took a lot of care to get this mussel out. That's not easy to get out is it Mike?
- MIKE: Yeah.
- RES: That was a lot of work getting the mussel on your hook.
- MIKE: Yeah.

RES: This is that black line too isn't it, Mike?

RES: Does it matter which corner of the dock you're on?

MIKE: No, not really, cause the food might attract them to that corner.

RES: Yeah, ok, that corner was your lucky spot.

MIKE: Yeah.

RES: So have you thought about why it's just that little circle that's missing Kate?

KATE: uh no.

RES: So with that big rod there, it was hard to see over the edge, wasn't it?

MIKE: Yeah.

RES: Do you remember what happens next?

MIKE: Yeah. I wonder if the hook's still in him?

RES: A couple of days maybe. So what about that theory that you had? Do you think color makes a difference?

MIKE: Maybe.

RES: So all the fish were caught off that spot weren't they Mike?

MIKE: Yeah.

RES: Here's Mike helping to untangle the old rod. Mike gives Kate advice here.

RES: I've got a few questions I'd like to ask you about the film. Maybe you could help me answer a few questions and after we could have some juice and cookies. So bring up your cushions a little bit closer here It'll only take about five minutes. So what kind of bait did you use mostly for these fish?

MIKE: Um, mussels.

RES: Mussels, and some herring? What were the perch doing to your bait Kate?

KATE: Um. They were making a hole in it.

RES: Making a hole in it. Yeah, it was curious the way they were taking from that one particular spot there. It looks like a steak there doesn't it? Like a halibut steak with

that one piece missing, yeah. Do you know what part of the fish that was that part they were taking?

KATE: Not really.

RES: It's probably it's insides, that part that's frozen maybe that was softer. So those shiners, when you lowered your bait, they were doing something together. What were they doing?

MIKE: They were um...helping.

KATE: Helping each other.

RES: (I motion with my hands fish all grabbing at one spot) And they all did this together? little bits instead of...that way they could help each other and they all got a little bit?

MIKE: And they wouldn't get hooked on the hook.

RES: So that's a good strategy then when they all work together. So if you see one shiner perch you'll probably see a whole bunch of them. What is it that attracts the perch to the float?

MIKE: Probably because of the clams maybe, and the mussels on the ropes.

RES: The mussels and things on the rope? Is that a good place for them to hide there Jill?

MIKE: Yeah, under the dock.

RES: Yes they could hide under the dock.

MIKE: From predators?

RES: Ok, what kind of predators?

MIKE: The seals? The sea gulls maybe?

RES: The sea gulls, yeah they like to eat shellfish. You've seen those blue herons there too. You see them on the edge of the dock and they can't reach them because they're underneath the float. So what do you think makes a better bait? mussels or herring? or lures?

MIKE: Ah, it depends on what you're fishing for.

RES: OK, here's someone who goes fishing a lot! So, when would you use herring and when would you use mussels?

MIKE: I would use the mussels for what we were fishing for.

RES: Ok the little shiner perch.

MIKE: And herring for the...bigger fish.

RES: Yeah, the bigger fish.

MIKE: 'Cause they've got bigger mouths.

RES: Yeah the bigger fish with bigger mouths. you saw that on the herring little tiny perch it had a little mouth so it can just nibble away at it. That's what they do with your bait. Just nibble away at it. How were your friends helpful?

KATE: With the lines like if they got all tangled up, and getting the bait on

RES: How were they helpful for you Jill?

JILL: I don't know.

RES: Ha ha. You were so busy thinking up strategies. Mike was helpful in many ways. Did you learn some new fishing strategies from your friends?

MIKE: Um yeah.

RES: Was there one part of the float better than another part to fish from?

MIKE: Um yeah, the corner by the...

KATE: 'Cause I caught a fish there.

JILL: By the shade.

RES: By the shade. Do you think that makes a difference? Ah, that's a thought. You think it's shadier on one side than the other? Do you think the fish would rather be in the shade or in the sun?

MIKE: The shade.

RES: Where you wouldn't be able to see them so well, would you? It's interesting that all the fish were caught off Mike's lucky spot. Whereas in the other films, they were caught on different places. Maybe it was just that day. Maybe they were all there in

one group and hung around one corner. So how is learning about fish and animals on the ropes while fishing from a float different from learning about these things in school?

MIKE: You have to go to school.

KATE: Because you get to fish and you don't have to really sit all the time.

MIKE: You can get good close ups and see what they look like.

RES: You can try different strategies? Some fishing books, and school text books say that fish like to eat herring, but is that always true?

ALL: No.

RES: It's like you said, it depends on what you're fishing for. You almost have to test it out too don't you? So Jill, what would you put on your fishing line to make it interesting for fish?

JILL: Bait.

RES: You were putting on lots of different kinds of things. What do you think kids, what would you put on?

MIKE: I'd put...

KATE: I'd put mussels maybe.

RES: Yeah mussels maybe. You had those herring little steaks didn't you? There's all kinds of things on the ropes there.

RES: Does the type of fishing line make a difference?

MIKE: Um no.

JILL: No.

KATE: No not really.

RES: Some are blue, some are clear, some are black.

MIKE: 'Cause I think Jill caught one with that um..

KATE: Yeah she did.

MIKE: With that clear line.

RES: With the clear line, so she caught one with the clear line and you caught two with the black.

MIKE: Three with the black line.

RES: You caught two with the black line and one with the clear line?

MIKE: No, I used the black line the whole time.

RES: So Kate, was your line black or clear?

KATE: It was black.

RES: Ah, the black line. So that old line I guess I should keep it for a while and not throw it away? You have been really helpful. I appreciate the help you have given me.

APPENDIX E1

Levels Of Engagement In Learning: Experienced (Sensory)

Kate	Jill	Mike
<u>Visual</u> experiences:	<u>Visual</u> experiences:	<u>Visual</u> experiences:
<ul style="list-style-type: none"> • seeing a harbour seal swim close by and under the float • seeing a school of perch feeding near the surface of the water around the float • seeing perch feeding on the encrusted ropes dangling beneath the float • seeing perch feeding near the bottom • seeing pliers break a fish hook in a perch's mouth • seeing several perch at a time nibbling bait from her hook • seeing a variety of sea life on the encrusted ropes • seeing hairy sea squirts on the ropes squirting sea water • seeing mussels growing on the edge of the float and on dangling ropes • seeing a treble hook bent out of shape by the action of a small perch • seeing pliers used as a tool to remove fish hooks • seeing perch follow her hook as she reeled it up • seeing sea gulls circling overhead • seeing perch nibbling at the thawing entrails of her herring "steak" 	<ul style="list-style-type: none"> • seeing a harbour seal swim close by and under the float • seeing a school of perch feeding near the surface of the water around the float • seeing perch feeding on the encrusted ropes dangling beneath the float • seeing perch feeding near the bottom • seeing pliers break a fish hook in a perch's mouth • seeing several perch at a time nibbling bait from her hook • seeing a variety of sea life on the encrusted ropes • seeing hairy sea squirts on the ropes squirting sea water • seeing mussels growing on the edge of the float and on dangling ropes • seeing a treble hook bent out of shape by the action of a small perch • seeing pliers used as a tool to remove fish hooks • seeing perch follow her hook as she reeled it up • seeing sea gulls circling overhead • seeing perch nibbling at her baited hooks 	<ul style="list-style-type: none"> • seeing a harbour seal swim close by and under the float • seeing a school of perch feeding near the surface of the water around the float • seeing perch feeding on the encrusted ropes dangling beneath the float • seeing perch feeding near the bottom • seeing pliers break a fish hook in a perch's mouth • seeing several perch at a time nibbling bait from his hook • seeing a variety of sea life on the encrusted ropes • seeing hairy sea squirts on the ropes squirting sea water • seeing mussels growing on the edge of the float and on dangling ropes • seeing a treble hook bent out of shape by the action of a small perch • seeing pliers used as a tool to remove fish hooks • seeing perch follow his hook as he reeled it up • seeing sea gulls circling overhead • seeing perch nibbling at his baited hooks

APPENDIX E1 continued

Levels Of Engagement In Learning: Experienced (Sensory)

Kate	Jill	Mike
<u>Tactile experiences:</u> <ul style="list-style-type: none"> opening mussels and removing the tissue from the shells feeling the slippery, slimy texture of mussel tissue on her fingers feeling the shape of mussel shells attaching bait to single and treble barbed hooks attaching herring to two treble hooks on one leader line (herring hook-up) 	<u>Tactile experiences:</u> <ul style="list-style-type: none"> opening mussels and removing the tissue from the shells feeling the slippery, slimy texture of mussel tissue on her fingers feeling the shape of mussel shells attaching bait to single and treble barbed hooks feeling the sting of an angry wasp relieving the painful sting in a bucket of cold sea water 	<u>Tactile experiences:</u> <ul style="list-style-type: none"> opening mussels and removing the tissue from the shells feeling the slippery, slimy texture of mussel tissue on his fingers feeling the shape of mussel shells attaching bait to single and treble barbed hooks attaching herring to two treble hooks on one leader line (herring hook-up)
<u>Auditory experiences:</u> <ul style="list-style-type: none"> hearing the cries of sea gulls circling overhead hearing the noisy outboard motor on passing boats hearing the creak of the ramp hinge as the float bounced up and down hearing the noise of a float plane's engine as it passed low overhead hearing the crunch of mussel shells breaking underfoot 	<u>Auditory experiences:</u> <ul style="list-style-type: none"> hearing the cries of sea gulls circling overhead hearing the noisy outboard motor on passing boats hearing the creak of the ramp hinge as the float bounced up and down hearing the noise of a float plane's engine as it passed low overhead hearing the crunch of mussel shells breaking underfoot 	<u>Auditory experiences:</u> <ul style="list-style-type: none"> hearing the cries of sea gulls circling overhead hearing the noisy outboard motor on passing boats hearing the creak of the ramp hinge as the float bounced up and down hearing the noise of a float plane's engine as it passed low overhead hearing the crunch of mussel shells breaking underfoot
<u>Olfactory experiences:</u> <ul style="list-style-type: none"> smelling herring and mussels on her hands 	<u>Olfactory experiences:</u> <ul style="list-style-type: none"> smelling herring and mussels on her hands 	<u>Olfactory experiences:</u> <ul style="list-style-type: none"> smelling herring and mussels on his hands
<u>Kinesthetic experiences:</u> <ul style="list-style-type: none"> the effect of a passing boat's wake on the float feeling the tug of a hooked fish on her line reeling in a hooked fish 	<u>Kinesthetic experiences:</u> <ul style="list-style-type: none"> the effect of a passing boat's wake on the float feeling the tug of a hooked fish on her line reeling in a hooked fish 	<u>Kinesthetic experiences:</u> <ul style="list-style-type: none"> the effect of a passing boat's wake on the float feeling the tug of a hooked fish on his line reeling in a hooked fish

APPENDIX E1 continued

Levels Of Engagement In Learning: Experienced (Perceptual)

Kate	Jill	Mike
<p>Kate demonstrated <u>empathy</u> when she:</p> <ul style="list-style-type: none"> released her caught shiner perch alive was concerned about the broken hook in the perch's mouth said she didn't want anyone to use the pliers to remove hooks from the next fish caught said "What if we hook the seal?" 	<p>Jill demonstrated <u>empathy</u> when she:</p> <ul style="list-style-type: none"> released her caught striped sea perch alive was concerned about the broken hook in the perch's mouth said she didn't want anyone to use the pliers to remove hooks from the next fish caught 	<p>Mike demonstrated <u>empathy</u> when he:</p> <ul style="list-style-type: none"> released his three caught perch (shiner, pile and striped sea perch) alive was concerned about the broken hook in the perch's mouth showed concern for Jill getting stung by a wasp helped Kate fish successfully rather than fish himself said he didn't want to hook the seal
<p>Kate experienced <u>difficulty</u>:</p> <ul style="list-style-type: none"> in trying to get the mussel flesh to stay on her hooks 	<p>Jill experienced <u>difficulty</u>:</p> <ul style="list-style-type: none"> in trying to get the mussel flesh to stay on her hooks using the reel, as her line came up when she thought she was reeling it down in seeing over the edge of the float while holding a nine foot rod 	<p>Mike experienced <u>difficulty</u>:</p> <ul style="list-style-type: none"> in trying to get the mussel flesh to stay on his hooks
<p>Kate experienced <u>frustration</u>:</p> <ul style="list-style-type: none"> frustration as she watched the perch stealing her bait but not getting hooked 		<p>Mike experienced <u>confidence</u>:</p> <ul style="list-style-type: none"> in casting his lure out from the float successfully in catching his fish
<p>Kate experienced <u>surprise</u>:</p> <ul style="list-style-type: none"> surprise at getting her fish hook caught in her sleeve, and puzzlement at how to get it out 	<p>Jill experienced <u>surprise</u>:</p> <ul style="list-style-type: none"> when she saw her bait "stolen" by the fish 	

APPENDIX E2

Levels Of Engagement In Learning: Explored

Kate	Jill	Mike
<ul style="list-style-type: none"> • untangling line from the tip of her rod • attaching pieces of frozen herring on her hooks • looking for large mussels on the encrusted ropes dangling beneath the float • looking for the mussel's tough muscular foot and securing it on her hook • using herring and mussels together as bait • using a fishing knife to cut frozen herring into different sized sections • pulling line out from her reel as well as turning the reel's handle • the sea life on the encrusted ropes looking for large mussels to use as bait • different ways to open mussels and getting them to stay on her hook securely • "mooching" for fish by dropping a baited hook on her line over the edge of the float and waiting for a fish to bite it • lowering her baited hook to different levels in the water to try and catch a fish • fishing from different spots on the float • using different colored fishing lines • different ways of putting mussel tissue on hooks securely 	<ul style="list-style-type: none"> • untangling line from the tip of her rod • attaching pieces of frozen herring on her hooks • looking for large mussels on the encrusted ropes dangling beneath the float • looking for the mussel's tough muscular foot and securing it on her hook • using herring and mussels together as bait • using a fishing knife to cut frozen herring into different sized sections • pulling line out from her reel as well as turning the reel's handle • the sea life on the encrusted ropes looking for large mussels to use as bait • different ways to open mussels and getting them to stay on her hook securely • "mooching" for fish by dropping a baited hook on her line over the edge of the float and waiting for a fish to bite it • lowering her baited hook to different levels in the water to try and catch a fish • fishing from different spots on the float • using different colored fishing lines • different ways of putting mussel tissue on hooks securely 	<ul style="list-style-type: none"> • untangling line from the tip of his rod • attaching pieces of frozen herring on his hooks • looking for large mussels on the encrusted ropes dangling beneath the float • looking for the mussel's tough muscular foot and securing it on his hook • using herring and mussels together as bait • using a fishing knife to cut frozen herring into different sized sections • pulling line out from his reel as well as turning the reel's handle • the sea life on the encrusted ropes looking for large mussels to use as bait • different ways to open mussels and getting them to stay on his hook securely • "mooching" for fish by dropping a baited hook on his line over the edge of the float and waiting for a fish to bite it • lowering his baited hook to different levels in the water to try and catch a fish • fishing from different spots on the float • using different colored fishing lines • different ways of putting mussel tissue on hooks securely

APPENDIX E2 continued

Levels Of Engagement In Learning: Explored

Kate	Jill	Mike
<ul style="list-style-type: none"> • jigging her line gently up and down while fishing and observing the effects • different ways of making the baited hook on her line go down (pulling out line, turning reel handle) • turning the simple reel in both directions to see its effect • using different kinds of bait, singly and in combination to test the effect on fish 	<ul style="list-style-type: none"> • jigging her line gently up and down while fishing and observing the effects • different ways of making the baited hook on her line go down (pulling out line, turning reel handle) • turning the simple reel in both directions to see its effect • using different kinds of bait, singly and in combination to test the effect on fish • using herring bait on the buzz bomb lure's treble hook • leaving her rod on the float deck with her baited hook dangling in the water • using the line at the end of the nine foot rod as a hand-line to pull up her hook and check her bait • using the fishing rod as a rake to try and grab a floating piece of kelp 	<ul style="list-style-type: none"> • jigging his line gently up and down while fishing and observing the effects • different ways of making the baited hook on his line go down (pulling out line, turning reel handle) • turning the simple reel in both directions to see its effect on the line • using different kinds of bait, one type at a time, according to the type of fish he hoped to catch • using herring bait on the buzz bomb lure's treble hook • using the spoon on the end of the fishing knife as a tool to open and scrape mussel tissue from shells • getting the hook of his lure stuck on the seaweed bottom, and getting it off again • using pliers to remove hooks from caught fish • baiting a herring hook-up and attaching it to a fishing line • untangling the black fishing line in the old reel • casting his line out from the confined space on the float with a nine foot long rod, spinning reel, and buzz bomb lure

APPENDIX E2 continued

Levels Of Engagement In Learning: Explored (Experimented)

Kate	Jill	Mike
On the float Kate experimented:	On the float Jill experimented:	On the float Mike experimented:
<ul style="list-style-type: none"> • using mussel tissue as bait on a single hook • using a herring steak on a herring hook-up • using herring and mussel tissue together as bait on a treble hook • using bare hooks to "fish" 	<ul style="list-style-type: none"> • using mussel tissue as bait on a single hook • using herring bait on a single hook, and on a treble hook • using two frozen herring tails on a buzz bomb lure's treble hook • using bare hooks to "fish" • using the head, middle, and tail sections of herring on the lure's treble hook • baiting her hook with seaweed • "casting" with a starfish 	<ul style="list-style-type: none"> • using mussel tissue as bait on a single hook • using herring bait on a buzz bomb lure's treble hook

APPENDIX E3

Levels Of Engagement In Learning: Explained

Kate	Jill	Mike
<ul style="list-style-type: none"> • that perch were just nibbling at the bait and wouldn't hold on • that she thought it was unusual for the perch to take a chunk out of the middle of the frozen herring, leaving a visible circular hole • that the fish were all there trying to get her bait at the same time • that the perch were helping each other and sharing the bait so they all got a bit • that "fishing does take patience" • that the fish kept moving away from her hook when she tried to get them out • that the bigger fish might be at the bottom and the little ones at the top • that the fish were smart because they don't seem to get hooked • that one fish was snagged but the hook must have ripped through its lip, freeing it • that the perch were going for the mussel rather than the herring bait • that mussels like living underwater better than at the shoreline • that she was using mussels as bait because that was what the perch were going for 	<ul style="list-style-type: none"> • that when the hook was lowered in the water the fish would "want it and grab it" • that the fish wouldn't bite the bare hook because there was no bait on it • that the frozen herring would fall off the edge of the float as the boat's wake rocked it • that she was going to feed the seal the piece of herring she left on the edge of the float • that the seal might eat the sea star she found on the ropes • that the fish stole her bait • that her line "keeps coming up when I'm reeling it down." • that the seal she named Andre went away because he didn't get any of her fishies • that she couldn't find the third barb of the treble hook because one section of herring had two barbs in it • that the fishies knew what was going to happen when she lowered her baited hook 	<ul style="list-style-type: none"> • that the herring is "supposed to be frozen" • that the large frozen herring would be good bait if "we're fishing for a huge fish" • that Kate had to go deeper with her baited hook, then she would catch fish • that the worm-like edge of the mussel was a good place to hook mussel tissue • that fish could see the black fishing cord and think it is something weird • that you are supposed to try and snag the fish to catch them if they won't bite the hook • that he was going to fish off the side of the float where he saw lots of fish • that mussels are on the dangling ropes because the water is deeper than at the shoreline • that mussels were on the ropes because "predators don't come this shallow" • that the best kind of bait depended on what you were fishing for • his technique for catching three fish in a row • that his success in catching fish was due to the black line. Later, he said both kinds of fishing line work

APPENDIX E3 continued

Level Of Engagement In Learning: Explained

Kate	Jill	Mike
<ul style="list-style-type: none"> • that if she jerked her line when the fish bites, maybe she could snag it • that the perch were eating mussels off the ropes dangling beneath the float • that salt water rusted things made of iron • that she had to bring her hook up when she knew she had lost her bait • that she was trying to hook the mussel through its foot • that the fish took the "better part" of the bait (the entrails) 		<ul style="list-style-type: none"> • that the perch like to be near the dangling ropes • that jigging a baited hook up and down was helpful in catching fish • that a passing boat's wake was making the float bob up and down • that he didn't want to catch the seal with his casting • that the perch were eating the "stuff" on the encrusted ropes • that to open mussels, "sometimes you can just step on them" • that the perch's mouth was too small to catch herring • that perch like to eat mussels • that the big fish were under the float because that's where the food was • that he would use a small piece of herring as bait because "they'll just be nibbling" • that the fish were helping each other, not fighting over the bait <p>On the float, Mike <u>educated</u> others when he:</p> <ul style="list-style-type: none"> • gave advice on how to catch fish (where to put the baited hook, jigging the rod, snagging the rod up)

APPENDIX E4

Level Of Engagement In Learning: Extended

Kate	Jill	Mike
<ul style="list-style-type: none"> • “salt water rusted things made of iron.” She realized that the broken hook in the fish’s mouth would probably rust away too. • “it must be the black line.” She linked Mike’s success at fishing with his use of a black fishing line. • “Maybe it’s just a streak of luck. Maybe it’s the bait.” She was making connections to her prior knowledge and experience to suggest factors that would account for Mike’s success at catching fish. 	<ul style="list-style-type: none"> • “I smell like salmon.” She was making a link between the smell of the slimy mussel flesh on her fingers, and her memory of how a salmon smells • “Whoa! Andre must be having fun!” She was enjoying the bouncing ride effect caused by a boat’s wake on the float, and thought that the seal would enjoy the ride also • “We can put salt water in our fish tank and keep him there.” She made the connection between a fish tank she had at home, and the physical needs of the fish for salt water • “I’ll show you. I see some pliers.” She linked the task of removing a fish hook from a fish’s mouth to the use of an appropriate tool such as pliers, which she had probably seen used before, or used herself. 	<ul style="list-style-type: none"> • compared the black cord fishing line to string • compared the hairy sea squirts to strawberries, and said it looks like a ___?_with hair • used a jigging action for his baited hook so that “fish think it’s alive” • called his blue and gold striped sea perch “a rainbow” • said the striped sea perch’s protruding entrails “looked like it was going to have babies or something” • asked if the perch’s dorsal spines were “spikes”

APPENDIX E4

Level Of Engagement In Learning: Extended

Kate	Jill	Mike
<ul style="list-style-type: none"> • “salt water rusted things made of iron.” She realized that the broken hook in the fish’s mouth would probably rust away too. • “it must be the black line.” She linked Mike’s success at fishing with his use of a black fishing line. • “Maybe it’s just a streak of luck. Maybe it’s the bait.” She was making connections to her prior knowledge and experience to suggest factors that would account for Mike’s success at catching fish. 	<ul style="list-style-type: none"> • “I smell like salmon.” She was making a link between the smell of the slimy mussel flesh on her fingers, and her memory of how a salmon smells • “Whoa! Andre must be having fun!” She was enjoying the bouncing ride effect caused by a boat’s wake on the float, and thought that the seal would enjoy the ride also • “We can put salt water in our fish tank and keep him there.” She made the connection between a fish tank she had at home, and the physical needs of the fish for salt water • “I’ll show you. I see some pliers.” She linked the task of removing a fish hook from a fish’s mouth to the use of an appropriate tool such as pliers, which she had probably seen used before, or used herself. 	<ul style="list-style-type: none"> • compared the black cord fishing line to string • compared the hairy sea squirts to strawberries, and said it looks like a ___?_ with hair • used a jiggling action for his baited hook so that “fish think it’s alive” • called his blue and gold striped sea perch “a rainbow” • said the striped sea perch’s protruding entrails “looked like it was going to have babies or something” • asked if the perch’s dorsal spines were “spikes”