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# Enhancing Motivation Using the Constructs of Flow in Museum Education Activities

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# ENHANCING MOTIVATION USING THE CONSTRUCTS OF FLOW IN MUSEUM EDUCATION ACTIVITIES

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by

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Doctor of Education

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# DEDICATION

I dedicate this work to the members of my family and to those that have offered me friendship and support beyond which I could have ever hoped.

First, my husband, Nathaniel, has given me encouragement during those times when I was attempting to leap tall mountains in a single bound (at least it felt like that). His unfailing belief in my ability to clear a mountain in one giant hurdle laid the foundation for the pursuit of my doctorate. His undying faith has propelled me forward.

My mother has, and continues to be, a great source of strength and love. She was my first and most significant teacher, and I credit her with teaching me to write. She is the inspiration behind my passion for writing, and I am eternally indebted to her.

There is always someone whose voice resonates loudly in the ear of a person undertaking a huge endeavor. For me that voice came from my father. His is the voice of perseverance, commitment, and dedication. It is only with the sound of his voice that I could complete my studies.

My brothers, Robert and Chris, are not only inspirational in their respective career accomplishments, but they are both amazing human beings- dedicated fathers, compassionate husbands, and caring brothers to me. There support has been the steady undercurrent that helped to transport me towards my dissertation goal.

Christen, my eldest daughter, has only known a mother consumed with the education profession. While I've been pursuing my dream, she has always been there waiting in the wings to read David a bedtime story or to take Ruthie to her ballet class. I am so grateful to her for this, and am committed to supporting her as she moves forward towards accomplishing her personal and educational aims.

A leader in her own right, my daughter, Moriah, has been able to advance and flourish in ways that are truly inspiring. I especially appreciate her accomplishments at a time when I have been focused on my work.

David, my only son, continues to thrill me as he grows in a manner that would make any mother (and teacher) swell with pride. Before long he'll be sliding through *Harry Potter* like it's a thin, fast-reading comic book.

Then there's Ruthie, a girl who can both plié like the most graceful ballerina and aggressively toss a basketball so it swishes through a net. She's come through my doctoral program alongside me- from newborn to nearly 4, poised for yet another year of preschool.

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These individuals have made all the difference.

## ABSTRACT OF THE DISSERTATION

Enhancing Motivation Using the Constructs of Flow
in Museum Education
by
Maria C. Grant
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While many extol the general value of museum fieldtrips, few can describe the specific parameters needed to make the excursion an educational benefit. Oftentimes, a day at the Museum of Natural History or time spent at the local art gallery is casually put into place with little forethought or attention to activity details. This research intended to utilize the parameters of flow theory and children's interest to investigate the phenomenon of student motivation while viewing an exhibit. Informal learning environments offer educators the opportunity to look beyond the halls of their campus in a manner that allows augmentation of curriculum and the opportunity to evoke interest and increased effort.

The study examined elementary school students in grade five who attend Rosa Parks Elementary School located in City Heights, California. Students were allowed to experience museum exhibits in two different ways: (a) one group was given tape recorders and was asked to critique exhibits, and (b) a second group was given a teacher-generated worksheet to complete. The latter group also carried digital recorders. The former task was intended to follow the parameters outlined in flow theory. The latter task was designed to represent a typical activity employed by teachers taking students on a fieldtrip.

Using the Experience Sampling Method (ESM), students were given a modified version of WebMAC Junior 2000, a survey based on Expectancy-Value Theory. The survey was designed to assess motivation. In addition, content knowledge acquired by both groups was evaluated using a content assessment tool. Several weeks after the exhibit activity, students were given the opportunity to view a web site of their own choosing. They were given three sites to choose from, one of which correlated to content found at the museum they had visited. Tape recordings were transcribed and analyzed for common themes, and post-activity interviews were conducted to clarify student perspectives. A grounded theory approach was used with the intent of exploring the phenomenon of motivation in an informal learning situation.

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## ACKNOWLEDGEMENTS

My dissertation journey began with words of wisdom from professors, colleagues, and friends. Despite the thoughts, suggestions, and even warnings, I found that the road I trekked turned out to be the one less traveled. Yet it was the perfect road for me.

The directors of the Joint Doctoral Program, Dr. Cheryl Mason from SDSU and Dr. Jerome Ammer from USD, both worked to make my doctoral travel substantial and momentous. The members of my committee-my chair, Dr. Doug Fisher, and my committee members, Dr. Bernie Dodge and Dr. Sue Zgliczynski, were my guides as I made my way over difficult terrain. I am deeply grateful for their counsel.

Dr. Dodge offered me thoughtful commentary- the kind that fuels reflection and contemplation, the elements that help to foster meaningful work. Dr. Zgliczynski provided me with the framework for actually creating a dissertation. For this and for her words of encouragement, I am thankful. To Dr. Fisher, I am evermore indebted. Not only has he taught me by his tremendous example as a leader at the vanguard of education, but he has also believed in my ability to affect change in a positive way as well. His confidence in me has left an indelible mark- a mark which has impelled me to choose the road less traveled. I will always be grateful for this.

Two roads diverged in a wood, and I-
I took the one less traveled by,
And that has made all the difference.
-Robert Frost

# CHAPTER 1

## BACKGROUND TO THE STUDY/STATEMENT OF THE PROBLEM

Fieldtrips to museums and zoos are often perceived as "fun" days for students-days where the confines of the traditional classroom are exchanged for the freedom of strolling through exhibit-lined hallways guided by docents ready to elaborate on the meaning of a Renoir painting or an Olivia Parker photo. Unfortunately the opportunity to stimulate intrinsic motivation is often missed. The excursion experience as a time for students with varying abilities and backgrounds to discover knowledge in different ways is sometimes ignored. Despite the commonly missed opportunity to consciously forward the educational experience during a museum visit, visitors to museums often describe the experience as motivating (Csikszentmihalyi & Hermanson, 1995). Semper (1990) believes that many returning visitors want to have fun while they learn.

Given this opportunity for built-in motivation, it is natural for schools to offer field excursions to zoos, aquariums, and art galleries. The struggle lies within the boundaries of the museum walls themselves. If the goal is to use such visits to augment and expand classroom learning, then the way in which curriculum is explored as a student wanders through an exhibit is paramount.

Csikszentmihalyi (1975) has examined activities described as autotelic (from the Greek auto=self and telos= goal, purpose). Such activities are defined as those requiring formal and extensive energy output on the part of the participant with few if any rewards. Participation in autotelic activities leads to flow experiences. Flow is the holistic sensation felt by an individual when he/she acts with total involvement (Csikszentmihalyi, 1975). Is it possible to promote a student flow experience through the orchestration of a museum visit? Is it conceivable that educators have the power to stimulate intrinsic motivation as students view ancient artifacts or pull levers on interactive exhibits? Are some methods of structuring visits superior to others? What is the role of a child's interest in motivation and learning?

Intrinsic enjoyment of learning seems to be connected to higher creativity (Csikszentmihalyi & Hermanson, 1995). Given the fact that museum exhibits offer the possibility of profound learning and creative expression, the exploration of ways in which students are motivated to learn is of foremost significance. Meeting the needs of a diverse student population, fostering a desire to learn, and a feeling of joy and involvement with learning- this is the driving force behind this research.

Most traditional classroom learning is dependent on extrinsic motivation-that is students are propelled towards an end through the hope of a reward or they may be driven by the wish to avoid a punishment (Csikszentmihalyi & Hermanson, 1995; Kohn, 1993; Kohn, 2002). For example, a student may work diligently in a particular class so that her "A" grade will reinforce her high status on a college application. Another student may complete a project so that he avoids being grounded for the upcoming weekend. These motivators are externally applied and often undermine the desire to learn (Csikszentmihalyi & Hermanson, 1995; Kohn, 1993). Conversely, intrinsic motivation drives an individual to participate in an activity because he/she feels it is worth doing for its own sake. Rewards are typically nonexistent in such cases. Learning accomplished via intrinsic motivation is spontaneous (Csikszentmihalyi & Hermanson, 1995), and may be the underpinning for life-long pursuits of education. Deep and lasting learning in a museum setting is dependent on intrinsic motivation.

Teachers, parents, and youth group leaders typically plan excursions to museums because they want to have fun while acquiring new knowledge (Semper, 1990). Visitors tend to wander and may only choose to view some exhibits and not others. Children considered unable to learn are often found to be profound learners in the context of a museum setting (Brandt, 1993). Unfortunately, museum visits are often considered peripheral to learning; however, if learning in museum settings cuts across boundaries that typically categorize students as learners and non-learners, then such visits should be central to school curriculums. In order for learning to be lasting and profound, it must suit the unique needs of the student. There is no archetype of needs. Instead, each learner comes to a learning situation with his/her own learning styles, intelligences, and rate of knowledge acquisition (Gardner, 1993). Subsequently, presenting a student with a museum setting in which he/she could peruse an exhibit at his/her own pace in his/her own manner seems like a logical outgrowth of the learning schema whose goal is to tailor curriculum to meet the needs of the unique child. When students experience phenomena in a museum setting, they are more likely to understand the concept when it is again presented in the traditional classroom. In the same manner that the wood of a guitar vibrates in sympathy with the pluck of a string, a student will experience "resonance" when curricular material is first experienced in another setting and then reintroduced in the school classroom (Brandt, 1993).

Oftentimes students are guided by teacher-created worksheets designed to focus learning towards the accomplishment of a particular set of tasks or goals. Guided tours are occasionally arranged with the intent of conveying specific knowledge regarding exhibits. Occasionally, students are set-free to scramble through exhibit halls with no direction or instruction at all. Teachers and youth leaders need to know which methods of instruction best foster deep learning through motivation and engagement.

Students who are intrinsically motivated tend to have higher achievement scores (Csikszentmihalyi & Hermanson, 1995; Csikszentmihalyi & Nakamura, 1989). Because the promotion of these types of scores is at the heart of what teacher's typically desire for their students, the encouragement of learning rooted in intrinsic motivation is of the utmost importance. In a related vein, flow is an experiential state in which psychic energy is invested in tasks in which external rewards are absent. Given this, it is clear that the parameters of flow must be met in order for students to have any hope of experiencing the autotelic self.

These parameters may be described with a look at general characteristics of flow experiences as outlined by Csikszentmihalyi (1975). First, flow occurs when tasks are within the scope of the individual's ability to perform. Along these lines, most flow activities have clearly designated rules for action. In addition, attention is centered on a limited stimulus field. All extraneous or unrelated stimuli are kept out of the individual's attention. Set rules often act to focus the participant's attention in a particular direction thus delineating what is relevant and what is irrelevant. The thought of some kind of personal gain or the thought of fear may also focus attention. While such motivations may initially be extrinsic, they tend to prompt intrinsic motivation in the larger scheme of the experience. Those experiencing flow typically describe a "loss of ego" or "self-forgetfulness." This occurs when the participant loses the need to negotiate with him/her self. Individuals in flow are in control of their actions and environment. Clear demands are provided and relevant feedback is experienced.

Students must have a sense of what is "good" and what is "bad," and they automatically act on this without stopping to evaluate the feedback.

Given the parameters that define the flow experience, teachers and youth leaders planning to lead students through a museum are in need of methods by which to offer students the hope of experiencing a learning opportunity built on the foundation of the flow experience. The goal of this research was to evaluate two methods of instruction in order to assess the propensity for stimulating learning based on children's interest, a construct that serves as a harmonic construct to flow.

The attainment of a state of flow while visiting a museum is a realistic and worthwhile goal even for younger school age children (grades 3-5). The difficulty lies in the assessment of the flow state as experienced by young children. Given the fact that the constructs of flow and children's interest have a parallel foundation rooted in the study of motivation, it is logical to assume that an exhibit that peaks the interest of a young child and offers the ability to achieve success, has the potential to foster flow. Dewey (1913) describes interest as "a name for the fact that a course of action, an occupation, or pursuit absorbs the powers of an individual in a thorough-going way" (p. 65). Dewey further notes that interest must not be merely and fleetingly caught, it must be maintained. A focus on the arousal of energy is not enough; instead, a look at the route the emerging energy takes is more paramount. It is the maintenance of the initiatory excitation that culminates in learning. While this research is concerned with the possibility of children experiencing flow in a museum setting, the focus is on one component that provides the potential to stimulate a flow experience, namely the construct of children's motivation.

## Purpose of the Study

The purpose of this study was to determine what aspects of museum exploration make a museum exhibit interesting to school age children. The sample included children in grade five (ages 10 and 11 years). The study examined two methods of instruction in a museum setting to determine whether or not one tends to incite more interest in the exhibit. The founding premise is that a measure of children's motivation in an exhibit is an indicator of the tendency to promote a flow experience.

Given the parameters that define a flow experience, a method of instruction that has the potential to meet the varying needs of the many different students that tour the exhibit, was examined and compared to more traditional means of instruction. The first method of instruction, an activity in which students critique exhibits, was designed to offer the students control over their own learning- a key element of the flow experience. In addition, this task, as presented to the students, afforded freedom of choice and autonomy. Each student had the choice to experience learning individually or to participate with his/her peers. These characteristics have been shown to be an integral part of the flow experience (Allison & Duncan, 1988). Because technology-assisted instruction allows for varying levels of challenge and affords the opportunity for immediate feedback- both components that spur flow- exhibits that employ technological innovations were reviewed in terms of student motivation. Student commentary regarding the use of technology was evaluated to determine whether or not the interaction with such exhibits was motivating. This was assessed by having students participate in a "children's motivation" survey. Thus data was gathered that represented the perspective of the children themselves. Comparisons regarding levels of motivation were made to similar students who were given a more traditional activity to conduct while visiting the exhibit. In addition, interviews were conducted to gain further understanding of the students' perspective in regards to exhibit exploration.

Because the attainment of content knowledge is of prime concern, a writing assessment that evaluated the acquisition of knowledge following the museum visit was given to students. Both groups of students, those experiencing the critiquing mode of instruction and the traditional group, were assessed for attainment of content knowledge.

The founding intent of this study was to determine how students are motivated when viewing a museum exhibit. Specifically examined were the effects of method of instruction and the use of technology-enhanced exhibits. Learning was also assessed using an instrument to measure comprehension of content.

## RESEARCH QUESTIONS

Museums offer students the opportunity to experience learning in an environment that is commonly viewed as more relaxed and enjoyable than a traditional classroom. Students may wander and focus attention at will. Learning is typically varied from student to student.

In contrast, antiflow environments, those that impede flow, typically involve monotony through repetition. This acts to generate a feeling of great boredom (Allison & Duncan, 1988). In such cases, time seems to be at a stand-still. Consider the numerous classrooms filled with wearied students gazing with anticipation at a clock whose hands seem to elude the passing of time. Museums offer a break from the monotony of the everyday classroom experience. Environments that are less constrained by outside guidance afford students the opportunity to experience spontaneous motivation. In this way students may grow and develop by becoming less dependent on predefined expectations and more reliant on internal motivation (Csikszentmihalyi & Hermanson, 1995), With this in mind, this study was designed to investigate student motivation in a museum setting. Two distinct modes of instruction were investigated.

The study centered on the following research questions:

- Will a method of instruction based on the parameters of flow actually foster motivation in a majority of students as they visit a museum exhibit?
- Will a technology-enhanced exhibit be able to generate motivation in students?
- How does motivation impact knowledge acquisition?

## RATIONALE AND THEORETICAL FRAMEWORK

This study was founded with two theoretical constructs in mind. The research itself was rooted in the theoretical model for enjoyment, namely the optimal experience known as flow. The assessment was based on the principles that underlie the expectancy-value theory. The bridge between these two constructs is motivation. Because the literature clearly delineates the substructure of flow as intrinsic motivation, this research intended to determine whether or not students were experiencing motivation through activities designed to foster learning in an informal setting like a museum.

Csikszentmihalyi (1975) reports that people who enjoy what they are doing enter a state of flow. "Flow activities" are those that provide opportunities for actions that match the individual's skill level, limit the perceptual field by excluding irrelevant stimuli, contain clear goals, and provide consistent feedback. Work and play are closely intertwined when flow is experienced. The antithesis of flow is boredom and anxiety, emotions often expressed by young people as they sit in the same classroom day after day. Flow activities are based on intrinsic motivation, and intrinsic motivation is the foundation of life-long learning. In addition, flow appears to be related to self-esteem. When both challenges and skills are high and in balance, self-esteem is highest (Wells, 1988). Carlson (1998) suggested that instructors and guides share leadership with students. Students may then construct their own meaning through personal connections that increase relevance.

The pursuit of flow was at the root of this study. By allowing students to control their own learning and pace, a teacher may be able to help spawn an engagement event whereby a student loses track of time, is completely immersed in the activity at hand, and experiences a challenge that matches his/her skill. The resulting increased self-esteem could then inspire extended learning sought out by the student through intrinsic motivation. This would be the ideal situation- a scenario we should aspire to create.

The expectancy-value theory is based on an individual's expectations for success and on the personal value he/she places on the activity or event. If an individual believes he/she is capable of succeeding in a particular task or endeavor and if he/she attaches personal value to the activity, motivation will ensue. Consequently, an assessment of motivation will be made using the expectancy-value theory. Because motivation underlies flow, it is assumed that a more motivating experience will highlight the possibility for flow.

## DEFINITION OF TERMS

Because the focal point of this research was motivation, and motivation is the underpinning of flow, the term flow must be thoroughly explained. Csikszentmihalyi (1977) explains flow as the sense of effortless action felt in the moments commonly described as being the best in an individual's life.  Flow experiences typically occur when an activity includes goals and rules that allow the individual to participate without having to stop and ponder the next step. Actions are automatic and completely consume the attention of the participant. The challenges posed by the activity match the skills of the participant, and feedback is immediate. Flow is also referred to as the optimal experience. According to Csikszentmihalyi and Csikszentmihalyi (1988), a person experiences flow when all the contents of consciousness are in mesh with the goals that define the person's self. These goals are the subjective states we call pleasure, happiness, satisfaction, enjoyment.

As aforementioned, flow experiences are characterized by intrinsic motivation, a desire to participate in an activity because of the activity itself. Intrinsically motivated behaviors are engaged in for their own sake, namely for the pleasure and satisfaction derived from their performance (Deci, Vallerand, Pelletier, & Ryan, 1991). Deci (1975) defines intrisically motivated behaviors as those in which a person participates in order to feel competent and self-determining. Intrinsically motivated behaviors may be classified in two ways- those that cause a person to seek out stimulation when it is not present and those that involve conquering challenges or reducing incongruity (Deci, 1975). DeCharms (1968) differentiates between intrinsic and extrinsic motivation as a distinction between the knowledge or feeling of personal causation. More specifically, when a person experiences himself/herself to be the locus of causality for his own behavior, he/she will consider himself/herself to be intrinsically motivated. Conversely, if the person perceives the locus of causality for his/her behavior to be external to himself/herself, he/she will consider himself/herself to be extrinsically motivated.

An understanding of consciousness is significant to a comprehension of a flow experience. According to Csikszentmihalyi (1990) to be conscious is to experience certain conscious events including sensations, feelings, thoughts, and intentions. An individual has the ability to direct the course of these events. Thus consciousness may be considered intentionally ordered information (Csikszentmihalyi, 1990).

The term autotelic refers to an activity that is done for the sake of the activity itself. The activity is the reward. The expectation of an external reward is not a driving force. Students are typically called on to respond to activities done for external reasons- activities called exotelic (Csikszentmihalyi, 1990). In a school setting, exotelic experiences typically involve the attainment of high grades, praise from a teacher/parent, or honor roll status as motivators. The pursuit of such external rewards may result in the attainment of prestige and admittance to a particular college. An ideal situation would be to pair the material profits of exotelic experiences with the feelings of control and enjoyment that come from autotelic experiences. Educational activities that promote flow through motivation may be a move in this direction.

The expectancy-value theory assumes that expectancies and values are influenced by task-specific beliefs like perception of competence, perception of difficulty of various tasks and personal goals and self-schemas. Expectancies for success may be defined as an individual's beliefs about how well they will do with a task in either a short-term or long-term context (Eccles, 2002).

The prospect of having a flow experience is dependent on intrinsic motivation. A clear understanding of flow and intrinsic motivation will illuminate the relationship that exists between the two concepts.

# CHAPTER 2

## REVIEW OF THE LITERATURE OVERVIEW

This section includes a review of the theoretical concepts underlying the study, specifically flow and motivation. While this research does not purport to assess flow as students visit exhibits, it does look at the closely related concept of motivation. The connection between the two concepts clearly warrants a discussion of each. An illumination of the power derived from participating in activities that inspire flow will manifest the motivation behind this research. This section also includes a consideration of the literature regarding the use of museum visits as a means to augment and support core academic curriculum. An understanding of previously published research regarding student experiences in museums will support the direction taken in this work. Finally, this chapter will review the literature related to the methodology that will be utilized in the study. Holes in the fabric that comprise the existing literature will reveal why this study is needed.

### THEORETICAL PERSPECTIVE: FLOW

Csikszentmihalyi in his seminal work *Beyond Boredom and Anxiety* (1975), sought to find the bridge between "work" and "leisure." His straightforward and simple goal was to understand enjoyment. This work was rooted in the literature regarding self-actualization, intrinsic motivation and play. It evolved into a more profound understanding of what comprises what is now termed a flow experience.

DeCharms (1968) explained, in his work regarding the concept of causation, that a motivated individual will cause things to happen. Motivation may come from two points of locus, internal or external. External motivators are numerous and, for the most part, generate only external rewards. In contrast, intrinsic motivators as they relate to learning in a school setting, seem to be more elusive. Intrinsic motivation is founded in the human need to be competent and self-determining in relation to a person's surroundings (Deci, 1975). Deci et al (1991) describe optimal adjustment as the experience of feeling good about oneself and acting intentionally to satisfy one's own needs while being tuned into social surroundings.

According to their work, the best way to support conceptual learning is to create conditions that simultaneously promote personal growth and adjustment. Motivation typically results in involvement in a particular activity. This involvement acts as an introductory request to the cognitive processes and thus stimulates the need to know (Carlson, 1998). Students who are intrinsically motivated have "learning goals" while students who are extrinsically motivated have "performance goals" (Csikszentmihalyi, 1995). In addition, intrinsically motivated students have been associated with higher achievement and more creativity (Csikszentmihalyi, 1995). Hennessey (2001) reports that, in addition to an individual's particular talents, domain skills, and creative thinking abilities, the conditions under which he/she works directly affects motivational orientation and the level of creativity.

Interest is foundational to intrinsic motivation (Hektner & Csikszentmihalyi, 1996). Dewey (1913) describes genuine interest as an account in which the individual grasps an out-going activity holding within his/her grasp an object of direct value. Intrinsically motivated individuals exhibit behavior characterized by concentration and engagement. Deci (1992) has investigated the concept of interest as it relates to motivation. According to his work, intrinsic motivation is often associated with an individual freely participating in an activity of interest. Interest is experienced when a person encounters novel, challenging, or aesthetically pleasing activities or objects in a context that allows satisfaction of the basic psychological needs and therefore fosters development. Intrinsic motivation is nurtured when the experiential components of interest, excitement and enjoyment intersect. Deci (1992) also notes that environmental factors may influence interest as when an individual is presented with challenges and gratifying activities that are locally available. In a similar vein, interests are effected by social contexts. According to Krapp, Hidi, and Renninger (1992), a review of interest research reveals that three major points of view regarding interest exist: (a) interest as a characteristic of a person, (b) interest as a characteristic of the learning environment, and (c) interest as a psychological state.

Some subject matter will need to be regulated externally because certain students have no inherent interest in the topic. This, however, is not the ideal situation. It is preferable to attempt to foster intrinsic motivation. The emphasis of relevance to the life of the student is often key (Csikszentmihalyi, 1990). Hektner and Csikszentmihalyi (1996) explain that, if students could find flow in school work, they would be more intrinsically motivated to do school work and to become self-directed learners. Consequently, the promotion of flow, within the framework of the school experience, could be vital to the personal and academic growth of the individual. This is what most teachers strive to accomplish within the realm of their profession.

The development of a propensity to experience flow seems to depend on an interaction between the developing cognitive and perceptual capabilities of the person and the resources of the environment (Hektner & Csikszentmihalyi, 1996). Flow is also known as the "autotelic experience," an homage to the fact that external rewards are not a factor in the flow experience-rather the motivation comes from inside the individual. In the flow state, an individual experiences a coherent movement from one moment to the next. He/she is in complete control of his/her actions with little distinction between self and environment, stimulus and response, or between past, present, and future (Csikszentmihalyi, 1975). A person in flow is aware of his/her actions but is not aware of the awareness. Thus attention is not divided. For this to happen the activity must be feasible. Specifically, the tasks to be performed must fall within the realm of the person's ability to perform them (Csikszentmihalyi, 1975). When challenges are too high, individuals may experience frustration, worry, and anxiousness (Csikszentmihalyi, 1995). In addition, to experience flow, an individual must receive immediate feedback (Csikszentmihalyi, 1975, 1995). The reaction to the feedback is automatic because the individual is able to meet the challenges. Consequently the individual feels in control of his/her environment and actions. This results in an experience known as "self-forgetfulness" meaning that the individual loses the self construct that typically interposes between stimulus and response (Csikszentmihalyi, 1975). Attention becomes completely centered on the field of stimulus.

Flow is an experience that generates enjoyment. Enjoyment is a forward movement defined by a sense of novelty and accomplishment (Csikszentmihalyi, 1990). According to Hektner and Csikszentmihalyi (1996), flow experienced in an educational setting promotes intrinsic motivation towards schoolwork. If teachers were able to organize the companion activities for a museum visit in such a way that would promote the characteristics related to the experience of flow, then perhaps students would be prompted to think more creativity and to acquire a deeper understanding of the conceptual ideas presented to them in the curriculum. To identify a propensity for flow, levels of intrinsic motivation must be assessed.

The Expectancy-Value Theory may be used to evaluate the components that comprise motivation.

## THE EXPECTANCY-VALUE THEORY

The Expectancy-Value Theory focuses on two prerequisites as determinates of the amount and quality of a person's effort in a particular task or activity: (a) the perceived value of the task and (b) an expectation that he or she can be successful in achieving that task (Arnone & Small, 1999b). Vroom (1964) describes the concept of expectancy as the effects on behavior due to the belief that outcomes will be probable. In addition, expectancies may be said to have strength. The greatest strength would indicate that an act will result in the subjective certainty of an outcome. Minimal strength is an indicator that the act will result in the subjective certainty that an outcome will not occur. Sheppard (2001) notes that the expectancy component of the theory refers to the perception that performance is contingent on effort.

For instance, a student may feel that more effort will result in better performance. Conversely, he/she may feel that a good performance is beyond his/her capabilities. The perception that the consequence of the performance outcome is contingent on performance is referred to as instrumentality and is a type of expectation (Sheppard, 2001). The value component represents the degree of value or importance attached to the accomplishment of the outcome of the performance minus the costs incurred to the individual. The costs may be psychological and/or material (Sheppard, 2001). Attitudes may be considered dispositions to evaluate psychological objects (Ajzen, 2001). The terms "object" and "attribute" are used to refer to any discriminable aspect of an individual's world (Ajzen & Fishbein, 2000). The expectancy-value theory suggests that an individual's overall attitude toward an object is determined by the subjective values or evaluations of the attributes associated with the object. As aforementioned, the strength of these associations plays a significant role (Ajzen & Fishbein, 2000). Oftentimes individuals connect more than one attitude to an object. According to the Ajzen and Fishbein (2000), the evaluative meaning arises spontaneously and inevitably as we form beliefs about the objects. Recent interpretations of the expectancy-value theory suggest that choices are influenced by both negative and positive task characteristics. All choices are assumed to have costs connected to them sometimes by virtue of the fact that the choice of one option often eliminates other options. Because of this, the relative value and probability of success of various options are foundational determinates of choice (Eccles, 2002).

## Museums, Education, and Current Research

A review of the literature regarding museum learning shows that the focus of most research has been centered on exhibit characteristics and the effect on learning-related behaviors (Barriault, 1999). Typically, observations are made, behavior checklists are reviewed, and exhibits are evaluated for effectiveness. Despite this, a few studies have recognized the uniqueness of the learning experience for each individual. One such study (Barriault, 1999) looked for patterns of behavior as learning occurred in a museum environment. Learning behaviors fell into the following categories: initiation behaviors, transition behaviors, and breakthrough behaviors. Initiation behaviors include the following: doing the activity, spending time watching others engaging in the activity, and information or assistance offered by staff or other visitors. Transition behaviors include repeating the activity and expressing positive emotional response in reaction to engaging activity. Breakthrough behaviors include referring to past experiences while engaging in an activity, seeking and sharing information, and becoming engaged and involved. The later descriptor includes the following behaviors: testing variables, making comparisons, and using information gained from the activity. According to Barriault (1999), a rich learning experience means many of these behaviors occur while a visitor engages with an exhibit.

Other studies have focused on the characteristics of typical museum-goers. These characteristics include the following: the placement of value on learning, the desire to seek out the challenge of exploring and discovering new things, and the placement of a high value on engaging in worthwhile activities during leisure time (Dierking & Falk, 1998). Dierking and Falk (1998) report that visitors find "hands-on" experiences to be most engaging. In particular, media such as CD-ROMS and computer opportunities are commonly cited as positive elements that foster interactivity. Dierking and Falk (2000) have looked at free-choice learning. They define this as lifelong learning that is intrinsically motivated and, for the most part, is under the choice or control of the learner. A significant percentage of lifelong learning in the area of science occurs within the realm of free-choice (Falk, 2001). I have found no studies that specifically look at methods of instruction in terms of the propensity to foster motivation. Instead, museum literature discusses exhibit design and effect on visitors along with parameters for positive learning environments.

Specifically, several themes exist in the literature regarding museums and education. First is the idea that museum exhibits, through the use of interactivity, hands-on exhibits, and/or the display of authentic articles can inspire awe, fear, a sense of thrill, and even peak curiosity. These sensations underlie motivation. What child would not be both thrilled and fearful at the sight of shrunken heads as is seen in the Museum of Man in San Diego's Balboa Park? Likewise, a life-size Tyrannosaurus rex as is found in London's Natural History Museum would no doubt peak the curiosity of most small children as it towers over their heads in a way that evokes visions of swamp-covered lands tromped by roaring creatures with long tails and spiky backs. Carlson (1998) has looked at what is called the "learn by doing" model. The founding points of this model include the involvement of children in hands-on activities that are typically deemed fun and involve little in the way of rewards or extrinsic motivators. Curiosity and interest determine what an individual chooses to attend to with the investment of psychic energy and because attention is a scare resource, what an individual chooses to attend to is significant. (Csikszentmihaly, 1995).

A second theme involves the students' ability to use, manage and complete tasks/assignments as they explore the museum. In his discussion concerning learning in interactive environments, Roschelle (1995) notes that engagement in the physical aspects of a challenging task can lead to reformulation of intellectual aspects of the task. According to Roschelle, designers should attempt to tap into the prior knowledge of students. The use of interactivity could afford an opportunity for different students with different abilities and varied intelligences to access information and to learn by interacting with the same exhibit. According to Gardner (1993), children need to become familiar with phenomena in a way that fits their own tempo, learning style, and profile of intelligences. Exhibits typically isolate a piece of the natural world or a concept from the complexities that exist in real-world situations (Semper, 1990). This makes grasping the concept straight-forward and direct. In addition, the challenges of the task must match the participant's skill (Csikszentmihaly, 1995). Castle (2001) looked at eight teachers from three settings, a community history museum, an art gallery, and a nature centre. According to her study, museum teachers tend to conceptualize learning in a way that represents it as an enjoyable lifelong process. This approach supports teaching methods that endorse a learner's own attempts to construct meaning from the exhibits. Eiserman (2000) suggests that museums have the ability to offer comfort, community, and conversation to exhibit viewers through mentorship. A feeling of comfort may be generated when visitors are offered attentive spaces where they feel valued. A sense of community is fostered as viewers join together to make sense of the displays. When viewers engage in conversation with a sense of reciprocity, they feel valued. These elements, according to Eiserman, contribute to a flourishing museum education program. Taylor (1990) conducted a study that focused on a visitor-centered learning model. According to this model, the museum educator acts as a facilitator instead of a director of the visit. Henderlong and Paris (1996) looked at the impact of partially completed exhibits on children's motivation and engagement in a hands-on science museum. They found that partially completed exhibits were more motivating than either fully completed or uncompleted exhibits for students in grades 1 to 6. Children clearly expressed a preference for interacting with exhibits that required their contribution to what was already started. Another study looked at teachers' needs in regards to museum visits (Mackety, 2003). The 130 Michigan state teachers surveyed for this study stated that they preferred hands-on activities that provided unique educational experiences using a variety of learning styles. Teachers also expressed a desire to have their students engage in activities that exercised students' critical thinking skills, helped students apply what they were learning to their daily lives, allowed students to be in a safe environment where they could make mistakes, and offered a balance between fun and academic learning.

Museum education programs of some sort have been around for several decades. Although little data exists regarding the success of particular museum education programs, those programs that have been evaluated have shown promise in relation to meeting their goals. Humm (1976) examined the Discovery Program, a part of the High Museum of Art in Atlanta, Georgia. The program was designed to instruct inner city 4$^{th}$ graders about the basic elements that underlie all forms of art- color, texture, shape, line, and motion. Humm's experimental group, those participating in the program, performed significantly higher in assessments examining acquired content knowledge than the control group, those that did not participate in the program. In another study, Moore (1997) examined the effectiveness of a post-modern approach to museum education. According to her study, such an approach would balance the message of content with provisions for a visitor experience that acknowledges expectations, interests, and values. Moore defines a postmodernist museum as one meeting the challenge to acknowledge how the museum and museum education fit into the context of the shifting cultural and socio-political structures of the current time. MacGregor (1992) suggests that a postmodernist museum might present viewers with paradoxes of unlikely choices or with cultural contradictions. Museum visiting is considered an active, challenging leisure choice with most American museum visitors holding the belief that education is a significant life-long pursuit (Dierking & Falk, 1998).

A third theme found in the literature involves the need for a relaxed museum environment. Rigid expectations of a student, either the student's own or those of someone else, may hinder concentration. Fixation on an external goal may cause anxiety (Csikszentmihaly, 1995). Environments need to be supportive. They need to offer choice, which in turn fosters a sense of trust, support, and security. A playful atmosphere may augment a relaxed environment by encouraging hands-on experimentation. Technology-based exhibits are particularly suitable for this. Visitors must be able to personalize their own space. This means that individuals must feel that they can wander and explore at will (Semper, 1990). Also contributing to a relaxed atmosphere is the fact that museum visits occur within a social context. This facilitates joint experimentation (Semper, 1990). Conversations that involve debate, clarification, and discussion of exhibits may lead to more profound learning. Schneider (2004) discovered that, because teachers tend to view education as empowerment, teachers whose students had the opportunity to visit informal learning environments, like zoos and aquariums, tended to leverage the experiences to support views of empowerment. For instance, teachers used shared experiences in informal learning environments as a way to access classroom curriculum and increase participation. Not only did these teachers tend to increase their science instruction, but they also chose to base curriculum on student interest which was identified during learning experiences in informal settings. Such changes in teacher approach to curriculum lead to the generation of more connections for students to traditional school elements and to higher self-esteem for students.

## A NEED FOR RESEARCH

As was expressed by Carlson (1998), a youth-driven model is characterized by self-directed learners who are impelled forward by choice, intrinsic reward, a sense of discovery, and a flow experience. Children must perceive that their activities have relevance to their futures and that they have the capability to complete the task at hand (self-efficacy). The question remains- how may educators best facilitate a motivating experience for their students? Much of the literature regarding museum education focuses on the value of free-choice learning in informal learning environments. Studies, opinion papers, and books have been written to extol the benefits of museum trips; however, gaps still exist in the literature. According to Falk (2002), nearly half of the public's science understanding and learning comes from the free-choice learning sector. This sector includes museums, television, radio, the Internet, magazines, newspapers, books, parks, and community organizations. It is therefore imperative that educators better understand the means by which this type of learning best occurs. Dierking and Falk (1998) report that visitors to museums universally express a desire to have a reciprocal relationship in which choices are given and made. In such cases, the visitor becomes involved and ultimately is an active participant in the experience.

Specifically missing is research-based information regarding instructional methodology, as it relates to motivation, for museum learning. The intent of this study is to fill this gap with knowledge gleaned from sound research- knowledge that has the potential to guide the way instruction is delivered in a museum setting. Teachers are always looking for a means by which to convey information and inspire creative thought. Fieldtrips need to more than just "fun times" spent outside the traditional classroom. The literature clearly describes the existence of educational museum riches just waiting to be mined. What is still unclear is the means by which to most effectively help students to excavate these treasures.

The literature regarding flow defines specific parameters that need to exist before the flow state may be achieved. This study intends to use these parameters to guide learning. Because intrinsic motivation is an underpinning of flow, the study will look at the possibility of inspiring motivation through a specific means of instructional methodology.

The hope is that this work will bridge the gap between what is known about the benefits of museum learning and what is still not known about the ways in which students may get the most from visiting an exhibit. Learning opportunities are repeatedly being missed by today's students. This situation needs remediation, and it is hoped that this research will help solve the problem. It is clear from a review of the literature that a flow experience would be a positive occurrence for children visiting an exhibit. While it was not the intent to determine whether or not a flow experience was possible for students studying in a museum, the literature explicitly describes the correlation between the assessed concept, motivation, and flow. This research purports to understand the means by which motivation may occur.

# CHAPTER 3

# RESEARCH DESIGN AND METHODOLOGY

## GROUNDED THEORY: GENERATION OF A NOVEL SCHEMA

Grounded Theory involves the discovery of a theory or abstract analytical schema of a phenomenon (Creswell, 1998). This study examined the phenomenon of motivation during museum visits. The goal of this research was to identify a means by which motivation may be encouraged in students visiting museum exhibits. Grounded theory is typically expressed in narrative form with a theory emerging at the close of the study. A visual picture is painted using narrative form. This methodology best suits this study because it allows the experience of exhibit touring to be described from the perspective of the students in a form that seeks to comprehend the meaning of their thoughts and words. According to Glaser and Strauss (1967), generating theory from data involves the development of hypotheses and concepts that come from the data. These hypotheses and concepts are systematically worked out in relation to the data during the course of the research. Because of this, the emergence of foundational categories that connect all pieces of data is paramount.

Because a grounded theory approach involves the generation of propositions or a series of hypotheses, it was anticipated that conceptual relationships would become apparent upon review and analysis of the data.

Because the data was dependent on the reliability and truthfulness of the student respondents, all efforts were made to ensure that the students felt comfortable and relaxed so that they could write and speak freely.

## DESIGN OF THE STUDY

The intent of this study was to offer two modes of learning to students visiting a museum exhibit. Because the participants were already part of an existing museum education program, for several weeks they were observed engaging in typical museum learning activities. The students were divided into two groups. Group one received a teacher-generated worksheet designed to guide students through the exhibit. Group two students were given digital recorders and were assigned the task of critiquing the exhibit in the way they deemed suitable.

The critiquing activity was intended to offer the elements that are considered essential to the flow state (Csikszentmihalyi, 1975, 1995). First, by allowing the students to determine how to describe the exhibit, they were offered control. The way in which they exerted control was unique to each individual; each student chose what to look at and what to say into the digital recorder. The hope was that they would meet the challenge with the unique skills they each possesses. If a student traversed the exhibit and recorded his/her ideas on the digital recorder, he/she met the goals of the activity. The progression of the recording endeavor served as feedback to the student that the activity goals were being met. Through interviews and analysis of the modified WebMAC Junior 2000 survey, the student's expectation for success and a value component were determined.

## PROCEDURES FOLLOWED FOR IMPLEMENTATION OF THE STUDY

The following steps were followed:

1. Half the students were given a teacher-generated worksheet designed to guide them through the exhibit. Students completed the activity. These students were allowed to carry digital recorders with the intent of recording utterances during the worksheet activity.
2. Each student in the other half of the sample were given digital recorders along with the instruction to critique the exhibit by recording thoughts, ideas, questions, and comments as they perused the exhibit. The following directions were given to students: Visit each of the exhibits listed below. You may visit the exhibits in any order. Read the directions found at the exhibit, try the exhibit, and then read the "What's going on?" section. Use your digital recorders to record your comments and ideas about the exhibit. You may talk about the following:

   *how the exhibit works*
   *what you think about the exhibit*
   *any other thoughts you have while visiting the exhibit*

3. After the museum exploration activity, members of both groups were asked to complete the modified version of WebMAC Junior 2000 (see Appendix A).
4. Two days later, a content knowledge assessment was administered to all students. The assessment required students to write a short answer response to the following prompt: You have recently visited ExploraZone 4 at the Ruben H. Fleet Science

Center. Many of the exhibits you saw at first may have seemed like magic. Using the knowledge you gained from your visit to ExploraZone 4, explain how science can help us understand exhibits that may seem like magic. Use examples or descriptions of exhibits you saw to support your ideas.

5. All students were interviewed regarding the museum experience within two weeks of visiting the exhibit. Interviews took about a week to complete.
6. Three weeks after the exhibit activity, students were asked to choose one of three websites to view. One of the websites presented content similar to that found in the visited museum. The focus of this website was optical illusions. The other two choices were science-related, but did not correlate to any content found in the museum exhibit. The latter two websites related to cells and Antarctica. Over the course of two weeks, students were allowed to choose a website to view.

## Setting and Sample

The study took place in a San Diego museum called the Ruben H. Fleet Science Center. Exhibit activities were all hands-on, with some employing technologically enhanced aspects, such as those found at the lightning globe and tornado exhibits. Such exhibits offered immediate feedback, varied levels of engagement, and the ability to exert control within the implementation of the activity. The exhibit itself is called ExploraZone 4.

The sample consisted of 18 students from Rosa Parks Elementary. These students were from a low-socioeconomic community where many families fall well below the poverty line. Approximately 48 % of the students from this population were non- or limited-English proficient (LEP) students with 75 % coming from homes where a language other than English is spoken. In addition, approximately 73 % of the students from the school where the participants attended are Hispanic, 11 % are African/African American, 14 % are Indochinese/Asian, and 2 % are White. Most of the students in this community come from families where parents have not graduated from high school. All of the students qualified for the free lunch program. Students were chosen from an existing "school in the park program" in which classes are taught, on a daily basis, in museum and zoo settings for several weeks at a time.

Students were purposefully divided into two groups based on data provided by the classroom teacher. Care was taken to ensure that two groups were similar in regards to gender and academic ranking. One group received a traditional worksheet activity along with digital recorders, and the other group used the recorders as the primary means of instruction by critiquing the exhibit in their own words.

In terms of composition, the sample population is representative of student populations found throughout the country. The National Center for Education Statistics (2002) reports that the 100 largest school districts in the United States consist of students of varying ethnic backgrounds, many coming from homes where languages other than English are commonly spoken. In addition, many states report significant numbers of Title 1 schools present in most major cities. The students participating in this study come from a community that is clearly representative of those in many parts of our country. These are students at risk of dropping out before they graduate high school. They are a population in need of intervention. There are similar students congregated in large numbers in all major cities. They are also found, perhaps in smaller numbers, scattered among the student populations of even the most affluent schools.

## INSTRUMENTS

Data were collected in several different forms. First, digital recordings from both groups of students were transcribed and categories were identified and named. Second, the worksheets (see Appendix B) completed by the first group were analyzed for an understanding of how aspects of the exhibit functioned and why they worked as they did.

Third, interviews were conducted following museum visits. An interview protocol (see Appendix C) was developed with the goal of digging deeper into the meaning of the activity as experienced by the student. Eighteen students were interviewed. The interviews lasted between 10 and 20 minutes and consisted of the following questions:

1. What do you think about this exhibit?
2. How did you feel while completing the assignment?
3. Were the instructions clear?
4. Did you feel confident/sure about what you were doing today? Did you feel like you were in control?
5. What did you learn today?
6. Was this assignment different or similar to activities you've done before?
7. Would you like to do a similar assignment on another day? Could you elaborate/explain your thoughts?

8. Is there anything else you'd like me to know about your experience today?

Fourth, the modified WebMAC Junior 2000 (Arnone & Small, 1999b) was used to determine whether or not the student was motivated while touring the exhibit and participating in the assignment given by the administrator (either worksheet or digital recording).

Fifth, a content assessment tool was utilized to assess attainment of knowledge regarding the science of the exhibits. Finally, students were given the opportunity to view one of three different websites displaying the following topics: Antarctica, cells, and optical illusions. Because many of the activities within the exhibit presented illusions, the final website choice was intended to be content-related to the exhibit.

The Experience Sampling Method (ESM) was used to administer the modified WebMAC Junior 2000. This meant that the students each carried copies of the survey and then paused, at the close of the activities, when signaled. The form was completed. The intent of using the method was to gather data in the hopes of revealing what was happening inside the individual. The ESM is designed to be non-intrusive. Specifically, the completion of the form is not intended to be an event in and of itself (Borrie, Roggenbuck, & Hull, 1998).

The validity of the ESM has been studied by Csikszentmihalyi and Larson (1987). They conclude that the ESM reports of psychological states covary in expected ways with the values for physical conditions and with situation factors such as activity. In addition, the measures of individual differences based on the ESM correlate with independent measures of similar constructs. Furthermore, they report that the ESM differentiates between groups expected to be different.

The modified WebMAC Junior 2000, the motivation instrument that was administered to the students, was altered to suit the museum environment. Construct validity was assessed by an outside expert, Ruth Small, the co-author of the WebMAC Junior 2000 instrument. Small is Associate Professor and Director of the School Media Program at the School of Information Studies at Syracuse University. WebMAC Junior 2000 was originally developed to evaluate motivational effectiveness of children's websites (Arnone & Small, 1999a). The intent was to help instructional designers and developers in the quest to enhance or modify websites. The tool captures the perspective of the child, also a goal of this study. It was studied by 21 educators and information specialists who were familiar with its theoretical underpinnings (Arnone & Small, 1999a). This team reviewed WebMAC Junior 2000 for clarity and comprehensibility, and analyzed items for face validity. Revisions were then made based on the information collected. In addition, the instrument was evaluated by children using a children's television program and its companion website. Observations and interviews provided data regarding the interpretation of individual items by students. Based on this data, the instrument was again revised.

The modifications made to WebMAC Junior 2000 were minor. The exact wording of the original instrument was used with the exception of the terms referring to websites. Website terms were replaced with terms related to the word "museum exhibit." The authors of the instrument have invited educators to use their instrument in different and varying ways to assess motivation (Arnone & Small, 1999b). The modified version has been reviewed by Small who stands as an expert consultant.

## Data Collection

Data collection proceeded as follows: Students were separated into two groups. Group one students were each given a teacher-generated worksheet that corresponded to the desired exhibit, along with a digital recorder. Group two students were given a recorder and the instruction to critique the designated exhibit. Both groups looked at the same exhibit on two different days. Care was given to reduce overcrowding by limiting the number of students visiting the exhibit at any one time. At the close of the exhibit visit, students were signaled to complete the modified WebMAC Junior 2000 form. A content knowledge assessment was administered to the students two days after participating in the museum activity. Within two weeks of the museum visit, students were interviewed regarding their experience. They were given the opportunity to elaborate on their personal experiences. Finally, students were allowed to view one of three websites of their own choosing.

## Data Analysis

Data analysis included a review of all types of data collected for each student. Concerning group one's activity, worksheets were examined for accuracy in response to questions. Additionally, group one's recordings were transcribed. For group two, recordings were transcribed and reviewed for categories by coding the data. This involved reading transcriptions and writing memos regarding context, categories, and content. This memoing phase looped in a spiral fashion to describing, classifying, and interpreting (Creswell, 1998). Emerging themes were then extracted. The constant comparative method of data analysis was employed. This entailed coding an incident for a category and then comparing it with previous incidents. If conflicts arose, ideas were recorded and coding was paused for further analysis and thought. Memos regarding students and their visible degree of engagement or activity while participating in the museum study, were recorded. A visual representation of the data was then created in the form of a chart with written descriptions and explanations of categories.

The WebMAC Junior 2000 data was reviewed using a plotting grid to assess motivation. Content assessments were graded and reviewed by a look at the number of correct answers. Interview data was recorded on a digital recorder with accompanying notes made with pen/paper when warranted.

Comparisons between the two groups were made again using a coding system and memoing. First open coding was employed. All of the documents were reviewed for salient categories of information. Once categories were established, data was reviewed until a category was saturated. Next, a central category was identified (axial coding). Interrelationships between categories were examined, including a review of conditions influencing the central category. Because all categories are not equally relevant, the depth of inquiry into each one varied (Glaser & Strauss, 1967). The "story" that connects the categories was then established (selective coding) and ties to theory, as portrayed in the literature, were made manifest.

A narrative that describes the categories that have emerged and the ensuing "story" that flows from the data was composed. Within this context, the research questions were addressed and emerging theory was explained in written form.

Glasser and Strauss (1967) recommend that substantive theory precede formal theory. Substantive theory is developed for a substantive area of sociological inquiry while formal theory is developed for a conceptual area of sociological inquiry. For this research, the substantive theory focuses on museum education for elementary school students. Formal theory emphasizes motivation in museum education. From the advancement of substantive to formal, a new theory that describes the possibilities for fostering flow via the occurrence of a motivating experience, were formulated. A strategy designed to make museum trips more effective and more pleasurable was sought through this research.

## DELIMITATIONS AND LIMITATIONS

The major delimitation encountered as this research proposal developed involved the decision to assess the construct of motivation rather than the construct of flow. This decision was made based on the thought that some children, especially the younger 5th graders that were a part of the sample, may not have the cognitive ability to determine or show whether or not they are in the flow state. The construct of motivation was instead chosen because it underlies the experience of flow. The assessment selected for modification and use, WebMAC Junior 2000, was specifically developed for elementary school children in grades 1-6. WebMAC Junior 2000 is designed to rate the motivational quality of various aspects of a website, but was easily adapted to assess other learning environments such as a museum. The assessment used smiley faces for recording responses, YES/NO questions, and two qualitative response questions. While the assessment itself did not determine flow, the activity design for group two was based on the factors that define a state of flow.

This study was conducted with students from one particular population. They all attend Rosa Parks Elementary School. Subjects are from a low-socioeconomic community. The population is comprised of 47.9 % non- or limited-English proficient (LEP) students with 75 % coming from homes where a language other than English is spoken. The conclusions drawn related specifically to these students from the community known as City Heights, California. While utilizing a narrow segment of our national student population may limit the ability to generalize results, it is assumed that conclusions drawn will apply to populations in similar communities with analogous student populations. This limitation opens the door for future replication research with subjects from divergent student populations. Because the academic support of students from low socio-economic communities is of prime concern, it was vital to conduct this research with such students-those who have the greatest potential for benefiting from the study.

A limited number of activities within the exhibit were used as part of this research. Activities were evaluated for the propensity to capture attention. Designs that offered well-developed aesthetic experiences alongside the use of authentic articles and technology integration were selected (Semper, 1990). It is assumed that these exhibits were representative of the many possible exhibits that students could encounter in a typical museum.

It should also be noted that the worksheet given to the worksheet group may have been more interesting than other possible types of worksheets. It was more akin to a notebook guide than a "fill-in-the-blank."

This study was dependent on gaining an understanding of the students' thoughts, attitudes and feelings. Because this is dependent on the researcher's ability to interpret what the student is communicating, several different means of collecting data were employed. The data was then triangulated to reveal commonalities and emerging themes.

## Significance of the Study

An examination of students as they interact with museum exhibits may reveal how and why learning occurs. Creating an environment conducive to flow is the optimal experience for an educator. Children in elementary school are naturally inquisitive as demonstrated by their common desire to seek out information and new learnings. This research hoped to offer a means by which motivation may be enhanced through activities that are developed with the construct of flow in mind. In addition, an understanding of student/exhibit interaction might provide a framework for effective museum curriculum development.

Some of the students participating in this study have had the opportunity to control their own learning. The power to make decisions about what and how to learn for these students was handed over to the learners themselves. Opportunities to access differing levels of challenge were explored for frequency and method of use in a technology-based setting. In addition, for the critiquing group, external motivators were minimized. The responsibility for defining activities while moving through the exhibit was left to the will of the student.

The outcome of this study has the potential to greatly alter the way in which teachers guide students through a museum. With the emergence of formal theory, teachers will be able to relinquish some control of learning environments to students. Extensions of this method of instruction could lead to revolutions in the style of teaching that will occur in the classrooms of tomorrow.

## FINAL THOUGHTS

While the methodology employed in this research is qualitative in nature, like a quantitative approach, it is ordered and organized so as to build on existing theory in order to generate new theory. Grounded Theory allowed me to probe into the thoughts and feelings of the student subjects. I was then able to express the meaning behind the data in narrative form using language that painted a vivid picture of what comprises effective and enjoyable museum education.

With high school dropout rates climbing across the country (National Center for Education Statistics, 2004), it is clear that novel methods of instructions geared at promoting intrinsic motivation should be at the forefront of research in education. This study hoped to understand the means by which to stimulate interest in learning in children so that school may be a focal point of creativity, willing participation, and future personal growth.

# CHAPTER 4

# RESULTS

The purpose of this study was to investigate the experience of children learning in a museum setting with a focus on understanding motivation. This chapter opens with an overview of the study and then presents an analysis of data as they relate to each research question. The questions focused on methods of learning in a museum setting, student motivation when visiting an exhibit, and knowledge acquisition. An understanding of student motivation as presented by the students themselves is discussed and themes that emerged through an analysis of recorded data and student interviews are presented.

## SUMMARY OF THE STUDY

Students were asked to visit particular displays in a science museum exhibit. Two groups of 8 to 10 students each visited the displays in two different ways. The first group was asked to complete a worksheet that required students to answer questions in written form as they perused each display. In addition, this group of students carried digital recorders that recorded utterances as they worked. The second group was asked to critique the exhibit by recording thoughts, comments, and ideas regarding the workings of each exhibit. Following the visits to the museum, every student was asked to complete the modified version of the WebMAC Junior 2000 survey. A week later, all students were individually interviewed regarding their museum experience. Three weeks after the museum experience, students were asked to select a website to explore. They were given 3 sites to choose from, one of which provided content related to the museum exhibit. Finally, a content knowledge writing assessment was administered to all students.

## PARTICIPANTS

Participants came from Rosa Parks Elementary School, located in City Heights, a part of San Diego County, California. The 18 student participants are from a community of low-socioeconomic status and are all English Language Learners (ELL). The students in one particular 5th grade class were all given the opportunity to participate if they were interested. Eighteen students returned permission slips authorizing participation in the study. Group assignments were made by the teacher based on the order in which students returned permission slips. She chose who would leave the classroom to participate in the worksheet activity and then who would participate in the critiquing activity. The first group consisted of 4 boys and 4 girls. The second group consisted of 3 boys and 7 girls. This second group was larger because more students wanted to participate on the second day. The teacher responded by assigning them to group two. To accommodate student interest in participating, two students were assigned to one recorder in two instances.

## RESEARCH QUESTIONS

The following sections address each of the research questions that were identified in chapter 1.

### Question: Will a Method of Instruction Based on the Parameters of Flow Actually Foster Motivation in a Majority of Students as They Visit a Museum Exhibit?

Two groups of students visited the museum exhibit using two different methods of engagement. One group had a traditional worksheet to complete with questions designed to elicit an understanding of how the displays worked and why they worked as they did. The second group was given instructions to use a digital recorder to critique the displays by describing what they saw and how they worked. They were also told that they could express how they felt about each display. The latter method was designed with the constructs of flow in mind.

Two types of causal conditions emerged from the data: (a) use of the digital recorders and (b) visitation of the hands-on displays themselves (see Figure 1). Students expressed various feelings regarding the use of the digital recorders. The students who had the task of completing the worksheets paid little attention to the recorders. It was clear from the transcript analysis that these students were much more focused on completing the worksheet and placed little effort on their utterances for recording. As Angela said, "I didn't pay much attention to the recorder as I worked." Students were often heard reading exhibit plaques and slowly transcribing thoughts onto paper. Much time was spent with formulating responses to questions. When interviewed regarding their concern with the recorders, these students said they didn't make a difference.

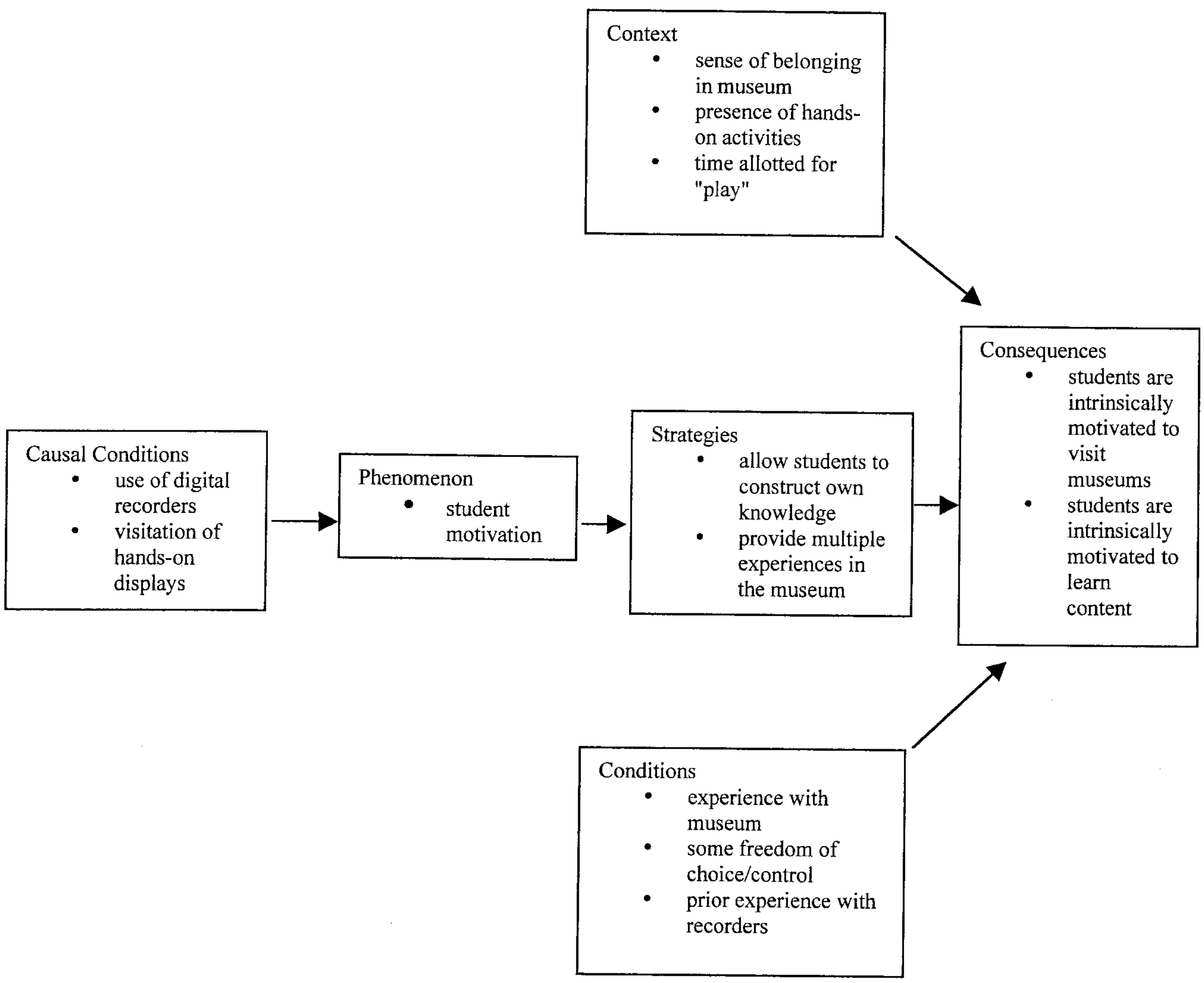


**Figure 1. Theoretical model for motivating students in a museum.**

In contrast, the students who were given the assignment to critique the displays using the digital recorders placed more focus on the recorders when reporting on their experiences. Most were excited about the use of recorders. For many, it was the first time they had used such a device. Cristina, a female member of the critiquing group, stated, "I was so glad because I never used a recorder before. I was excited." Another female participant, Mariana, expressed her thoughts by saying, "You could talk to yourself. You had your own opinions and thoughts." Mariela, also female, concurred, "I'd rather use the recorders than a worksheet. I'm not a good speller. You can talk and play with the thing. Writing means you lose time. You can't play while you're writing and erasing." Mariela added, "It's not just for the teacher. You're doing it." Luis, a male student, said, " I like being in the limelight. Having the recorder made me feel this way." This suggests that carrying the recorder made this particular student feel important- like a movie star or celebrity that is offering his thoughts to the public. Ana, yet another female participant, apprehensively said, "I felt nervous because it was the first time I talked in a recorder." The latter comment constituted the only sentiment of anxiety regarding use of the recorders. All other students were enthusiastic about using them.

The most prominent causal condition was provided by the presence of the interactive displays themselves. All forms of data revealed that engagement with hands-on science displays was without doubt the most motivating aspect of the student experience. Every student interview revealed that students enjoyed visiting the exhibit. Regardless of the instructional method used (worksheet or critique), students thought the displays were attention grabbing. Juan, a male student, when interviewed about his thoughts regarding the exhibit responded, "It was fun. There was a lot to do with your hands." Female student Magdalena, declared, " It's not about listening or pencil and paper. You can touch things."

Three weeks after visiting the museum, students were given the opportunity to visit science-related websites. All were interactive and all had colorful, engaging splash screens. Students could choose from the following three topics: Antarctica, cells, and optical illusions. The latter topic, optical illusions, was thematically related to the museum displays visited by the students. Most of the displays had some element of illusion to them. For instance, one display had rods made of different materials that were submerged in a liquid. Because of their refractive properties, some rods were visible and others were not. The displays allowed students to experience illusions and also provided explanations of the science behind the exhibit. For the group that critiqued the exhibit with the recorders, 5 out of 10 students chose to visit the optical illusion website. Three wanted to visit the Antarctica site and two wanted to visit the cells site. All eight students of the worksheet group chose to visit the optical illusion site (see Table 1). While it's not definitively clear that students chose the optical illusion website solely because they were inspired by their museum visit, it is evident from comments made during the website sessions, that the exhibits played some role in motivating student choice. Josef, a 10-year-old boy stated, " I want to see how it works. Going to the museum made me more interested. It's fun." Another student, Joel, also a 10 year-old boy, expressed his opinion, "I think it's cool to see something that looks different, but it's actually something else. In the museums we saw 3-D. I want to see similar things in 2-D." It should be noted fifty percent of the students from the critiquing group chose to view the Antarctica or cells web sites. Consideration should also be given to the possibility that the critiquing group thought they had learned more about illusions and wanted to explore other topics.

**Table 1. Student Website Choices**

| | Antarctica | Cells | Optical Illusions |
|---|---|---|---|
| Worksheet Group | 0 | 0 | 8 |
| Critiquing Group | 3 | 2 | 5 |

A modified version of WebMAC Junior 2000, a tool designed to evaluate two components of the exhibit activity, how well it worked and interest level, was scored and plotted on a grid (see Figure 2). Presence of these components, in a positive sense, are critical to motivating students. To determine the x and y components to be plotted on the grid, scores were tallied from the survey itself. Each response earned a score of 0, 1, 2, or 3 (see Appendix D). Odd responses were summed to determine how interesting and even responses were summed to determine how well it works. These summations were calculated for each student and then used to determine an average score for each group (see Table 2 and Table 3). The average score was plotted on the grid and then used to evaluate the exhibit activity. In both groups, average scores revealed that the exhibit activity worked very well and was very interesting. This correlates to an "awesome activity" according to the instrument. Both methods of learning, worksheet and critiquing activity, were equally well functioning and highly interesting from the perspective of students.

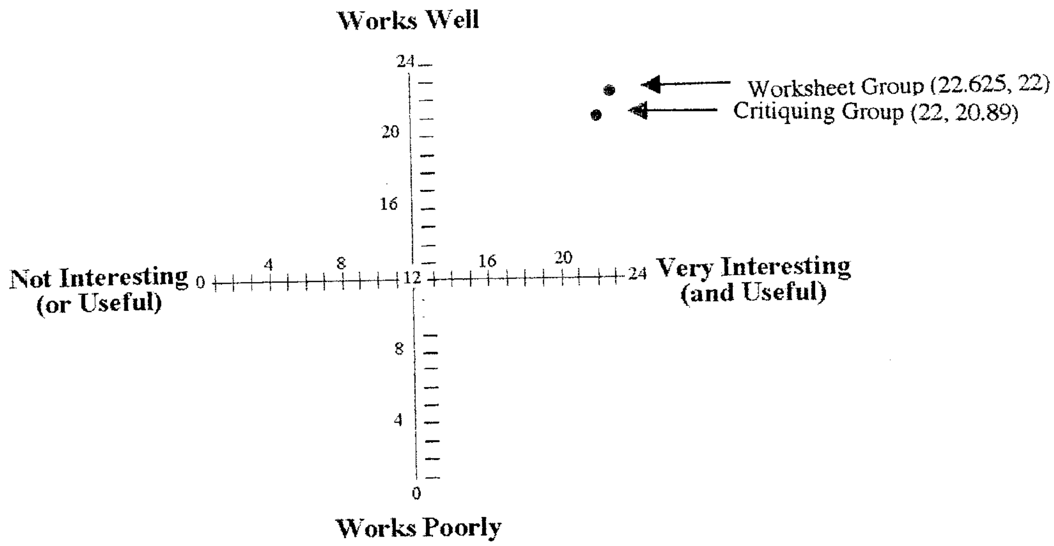


**Figure 2. Modified WebMAC Junior 2000 data plot.**

**Table 2. Modified WebMAC Junior 2000 Class Tally for the Worksheet Group**

| Student | A (How interesting) | B (How well it works) |
|---|---|---|
| 1 | 22 | 21 |
| 2 | 23 | 22 |
| 3 | 24 | 23 |
| 4 | 20 | 21 |
| 5 | 24 | 24 |
| 6 | 23 | 23 |
| 7 | 24 | 22 |
| 8 | 21 | 20 |
| Total Scores | 181 | 176 |
| Average Scores | 22.625 | 22 |

**Table 3. Modified WebMAC Junior 2000 Class Tally for the Critiquing Group**

| Student | A (How interesting) | B (How well it works) |
|---|---|---|
| 1 | 24 | 24 |
| 2 | 24 | 24 |
| 3 | 23 | 21 |
| 4 | 20 | 20 |
| 5 | 21 | 19 |
| 6 | 24 | 20 |
| 7 | 20 | 20 |
| 8 | 21 | 23 |
| 9 | 21 | 17 |
| Total Scores | 198 | 188 |
| Average Scores | 22 | 20.89 |

These two causal conditions, use of the digital recorders and engagement with hands-on activities, resulted in one major category of subjective phenomenon as reported by the participants: motivation. When asked if they would like to do another similar assignment on another day, every student, regardless of group assignment responded affirmatively. Irma, a female student in the worksheet group, enthusiastically stated, "I think this is one of the best museums." Another student from the worksheet group, Roberto, a male, expressed his response, " This is a very unique experience. You had the whole museum. You weren't in a small room. I like the combination of classroom and museum."

Respondents from the critique group answered in a similar vein. Manuel, another male student, stated, "I like to talk my thoughts. I'd rather be at School-in-the-Park than in my regular classroom." Ten-year old Mariana affirmed, "Yes, I'd like to do this again. I learned how to do the recorder and about science." Lourdes, a female participant, proclaimed, "Yes, I'd like to do this again. I want to learn more things." Many students used the descriptor, "cool" when talking about the exhibits. When responding to the query, "What do you think about this museum?" Ten-year old Cristina definitively stated, "It's the coolest museum." Angelo excitedly recorded his thoughts while viewing an exhibit called the beam bridge, "Whoa! It feels cool. Whoa!" Such exclamations of thrill were noted throughout the recorder transcriptions.

Strategies for learning have evolved in response to an analysis of what motivated the students to pursue an understanding of science during this study. It is important to first look at the context from which these strategies have emerged. Three contextual markers related to the causal conditions have been identified: (1) the development of a sense of belonging in a museum setting, (2) the existence of hands-on opportunities, (3) a sufficient allotment of time dedicated to "play."

The students that participated in this study have spent significant amounts of time in various museums and at the zoo for several years. They have interacted with museum personnel and have developed a rapport of sorts with the museums. Students are clearly comfortable with asking questions, reading museum plaques, and moving through exhibits. When asked, "Was this assignment different or similar to activities you've done before?" every student in the worksheet group indicated that they had completed a worksheet in a museum setting before. The critique group unanimously indicated that it was different or slightly different than any assignment they had completed before; however, the only noted difference was with the use of the recorders. The experience of being in a museum was familiar to students of both groups. No anxiety was expressed regarding student presence in a museum. It is critical to note that students similar to the participants from this study, specifically those coming from a community of low socio-economic status, do not commonly spend extended amounts of time in a museum setting. The subjects studied have had a rare opportunity. It is clear that prior experience in a museum has helped to establish a climate of comfort that may not have existed otherwise. Perhaps this is a point for future study. As Josef stated, "It was easy to find stuff. It's like a playground. The worksheet and plaques were both easy to understand." Luis acknowledged, "If you get stuck, you read the passage." He was referring to the plaques found at each exhibit. Every student responded affirmatively to the question, "Did you feel confident/sure about what you were doing?" When asked, "How did you feel while completing the assignment?" All but one student responded positively. According to Roberto, "It was a challenge, but I could meet the challenge." Mariana added, " I feel happy because I'm doing something cool." Susana concurred, "I felt like I was learning." The only student to express unease, Ana, as aforementioned, responded, "I felt nervous because it was the first time I talked in a recorder." Her apprehension clearly stemmed from her inaugural experience with the recorders and not from being in the museum.

The second noted contextual marker, the existence of hands-on opportunities, was mentioned numerous times by students from both groups. Susana expressed her sentiments, "This museum is great and you should bring your family. You get to learn and have fun. You can touch and use the stuff." Juan added, "There was a lot to do with your hands." Both groups were decidedly engaged in actively participating in each exhibit. Students wanted to participate, and willingly traveled from one exhibit to another. As aforementioned, a student in the critique group preferred working with the recorders because she felt it provided more time to actively participate at each exhibit. Every recording transcript vividly painted a picture of a student engaged in numerous activities such as placing hands in the midst of the mini tornado or touching the lightning globe so that electrons follow hand movement. Students questioned and predicted- investigative science processing skills that are critical to success in a science classroom. When referring to the display called touch the spring, Mariela questioned, " So why does your hand go through?" She then answered her own query, "It goes in because of the light rays and then there's a mirror that reflects it and it makes is seem like it's there, but when you touch it, it's not there." At the caternary arch display, Roberto predicted, "The arch is supported by other pieces of the arch because it's like teamwork. Without a team, you can never make it."

The last contextual marker, a sufficient allotment of time dedicated to "play," was mentioned or suggested by several students from both groups. Juan, from the worksheet group, described his experience as, "more relaxing and less stressful, like play." He added, "After you finished, you could play around." As would be expressed during a play experience, students had fun. According to Magdalena, "It was fun. It's like magic tricks." In a similar vein, Roberto added, “It was great to see that all these things that seem like magic can be explained by science.” Students clearly appreciated the opportunity to learn in an informal, enjoyable setting. When asked if the prefer the School–in –the Park (SITP) experience or a traditional classroom experience, no one said solely the latter (see Table 4). Three students from the worksheet group out of eight preferred SITP. The rest thought a combination of the two would be best. All but one student from the critique group stated that they would prefer a combination as well. That one student said he’d rather be at SITP for all of his studies.

**Table 4. Student Learning Environment Preferences**

| | School in the Park with Museum Experiences | Traditional Classroom | Combination of School in the Park and Traditional Classroom |
|---|---|---|---|
| Worksheet Group | 3 | 0 | 5 |
| Critiquing Group | 1 | 0 | 9 |

Along with context, there were intervening conditions that influenced the students’ motivation experience. Three such conditions were identified: (1) prior experience in a museum setting with trained personnel and/or a supportive teacher, (2) novelty use of the digital recorders, and (3) some freedom of choice/control.

As mentioned, the subjects had a great deal of experience with learning in a museum. In addition, they had a classroom teacher who was skilled in the practices of developing and implementing academic instruction in informal learning settings. This particular teacher, Ms. Andrews, has worked with these students since kindergarten. She is familiar with their home life and their parental support systems. According to Ms. Andrews, “It’s like a family.” In reference to the SITP program, Ms. Andrews added, “I've seen kids that have a hard time in a typical classroom and here they can shine. It's more hands-on.” Ms. Andrews is a definite support for these young people and is a key factor in creating the conditions for motivation to learn. She knows how to make explicit connections between museum learning and personal experiences.

For all but one previously mentioned student, use of the digital recorders allowed students to engage in a novel experience. Lourdes conveyed this when she said, "I love to talk with the recorders. It's an excitement." Especially for the group exclusively focusing on using the recorders for critiquing, the experience was new and exciting. Cristina stated, " I was so glad. I never used a recorder before." Perhaps future research could determine the duration and extent of this novel experience. Maybe the excitement would wear off with extended use of the methodology. Further investigation is clearly needed.

The last significant condition affecting motivation was derived from the students' positive reactions to some freedom of choice or control over the activity. While the original intention of the study was to allow students more freedom of choice and therefore, more control over their knowledge acquisition through the critiquing activity, analysis of the data revealed that students sensed freedom of choice as they were given the ability to wander from exhibit to exhibit in the order and for the duration of time of their own choosing. Like Semper (1990) suggested, individuals must feel that they can wander and explore at will. Transcript data shows students making conscious choices based on personal attraction to an exhibit. Roberto demonstrated this when he said, "I'm going to the lightning globe. Watch this!" He continued this conversation with another student, and clearly articulated his understanding of the exhibit. Later in the transcript, Roberto is heard to say, "Come on. Let's go find the spring." Students seemed to revel in the fact that they could go where they wanted, when they wanted. There was no significant difference in the perception of level of control/freedom of choice between groups. Instead, the feeling of control/freedom of choice was expressed by both groups equally in terms of movement throughout the museum.

Two strategies have emerged from a look at the phenomenon of motivation in the presence of the described context and the intervening conditions. These are: (1) provide students with an opportunity to experience science learning in a situation where they are allowed to construct their own knowledge and (2) provide students with numerous experiences in informal learning settings such as museums, zoos, or the natural environment.

The first strategy entails providing students with the opportunity to have some freedom of choice while still staying within the framework of the learning goals. In terms of this study, all students had to visit certain specified exhibits; however, they could do it for the length of time and in the order they saw fit. Review of transcript data showed that students were speculating. In regards to the disappearing glass rods exhibit, Susana thought, "Maybe the water is affecting how I see the rods." She was constructing her own knowledge. Students in the critiquing group reacted to exhibits with personal queries and explanations regarding the workings of exhibits. These were mostly articulated in students' own words. Students in the worksheet group tended to have more precise explanations for exhibit workings; however, some were derived word-for-word from the plaques. In both cases, students appreciated the chance to move through a large space in the way they saw fit.

Students clearly had an established sense of belonging in this museum. Several bragged about being there before, and seemed to express a sense of ownership. This was not merely a highbrow establishment for the elite of society- this was their place of learning. Several students voiced the desire to bring their families to the museum. On one occasion a parent was present as a visitor in the museum classroom. The teacher indicated that this was not uncommon. Repeated visits to the museum have helped to create this pervasive feeling of comfort and self-assurance that the students exude as museum learners.

The consequences of the museum learning experience are twofold: (1) students are intrinsically motivated to visit a museum and (2) students are intrinsically motivated to learn science content. As Deci (1992) expressed, interest was piqued by the environment-in this case, by the museum environment, and gratifying activities were available. While it was clear that the critiquing activity, with its design rooted in flow theory, was a motivating strategy for the students, the critiquing plan itself was not solely or most impressively responsible for the motivation experienced by the students. In fact, it seemed that the hands-on nature of the exhibits and the novel use of the digital recorders were the most compelling incentives for students to move forward with the exhibit activities. Students from both the critiquing group and the worksheet group were equally motivated to engage with the hands-on materials at the exhibit. In addition, both were clearly compelled to understand and explain the workings at the exhibit displays.

## Question: Will a Technology-Enhanced Exhibit be Able to Generate Motivation in Students?

While none of the museum displays possessed computer screens or mouse control options, two exhibits employed technology in their structure and all related in some way to the engineering sciences in their design. Technology may be defined as a manner of accomplishing a task especially using technical processes, methods, or knowledge (merriamwebster.com). All of the displays at the exhibit would be considered technology-enhanced according to this definition. While the definition of technology is a bit nebulous, the data derived from this study clearly suggests that hands-on engagement is highly motivating for students visiting museum exhibits. Because this study used a grounded theory approach to investigate motivation, it became evident that the definition of the term technology-enhanced would need to be broadened to include all displays related to technology in any peripheral way.

The primary causal condition responsible for the phenomenon of motivation through use of technology was simply the incorporation of hands-on opportunities for the museum-goers. Hands-on may be defined as relating to, being, or providing direct practical experience in the operation or functioning of something (merriamwebster.com). The ExploraZone 4 exhibit through which the students traversed for this study, provided students with numerous opportunities to physically engage with the display artifacts. Visitors are encouraged by museum personnel and by plaque instructions to participate in their own learning through touching, manipulating, and taking action. The result is that students construct their own meaning regarding the science behind the display's function.

When looking at the phenomenon of motivation through use of technology, constant comparison revealed the existence of the following categories: diagramming, explaining, and developing organized thinking strategies (see Figure 3).

The following query, designed to assess learning through writing, was given to students:

*You have recently visited ExploraZone 4 at the Ruben H. Fleet Science Center. Many of the exhibits you saw at first may have seemed like magic. Using the knowledge you gained from your visit to ExploraZone 4, explain how science can help us understand* *exhibits that may seem like magic. Use examples or descriptions of exhibits you saw to support your ideas.*

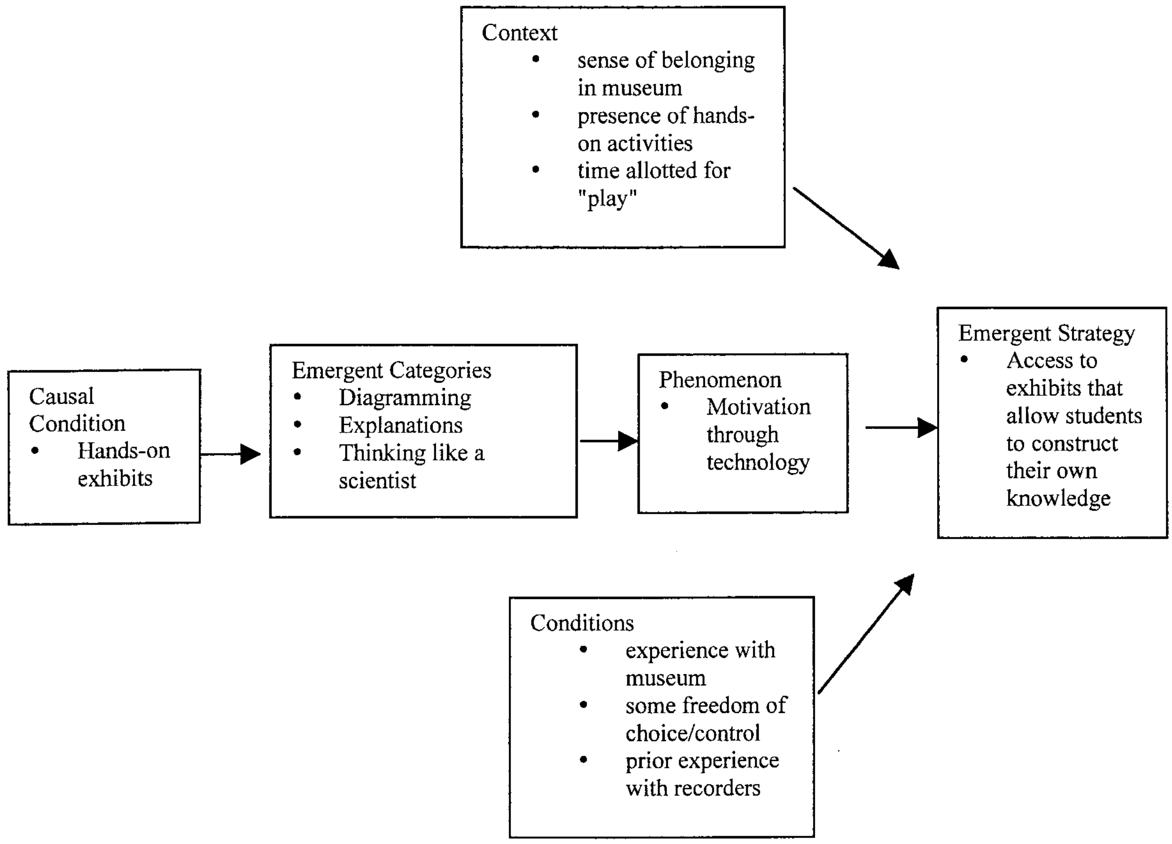


**Figure 3. Theoretical model for motivating students through use of technology-enhanced displays.**

Student responses helped to flesh out the aforementioned categories. Many students developed diagrams in response to the questions. They visually depicted the workings of the display to support their understanding of the technology components of a particular aspect of the exhibit. For example, 10-year old Magdalena developed a diagram of the touch the spring display (see Figure 4). She sketched the real spring, the image, mirrors, and locations of reflection. Juan, an 11-year old, created a simple version of a touch the spring diagram along with sketches of the caternary arch, lightning globe, braceable bridge, and the tornado. All of the students who diagrammed were in the worksheet group.

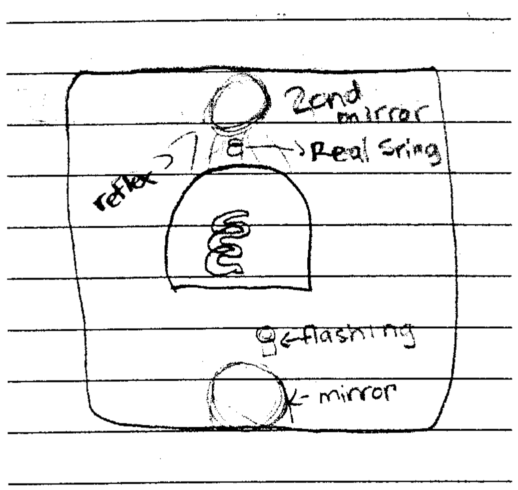


**Figure 4. A student's diagram of the *touch the spring* display.**

Students also concerned themselves with explanations of the hands-on experience. In reference to the touch the spring display, Magdalena stated,

> How this works is that in the bottom theres a mirror and a flashlight is hitting the other mirror in the other side. And where the 2nd mirror is there is the real spring in front of it. So when you try to touch the spring you can't.

To explain the refractive properties of different materials, Josef described the disappearing glass rods display as follows: "The rod that you could see was made out of flint. The one's you couldn't see where made out of pyrex." These students were from the worksheet group, but the critiquing group had similar explanatory responses developed in reply to the prompt. Many students from the critiquing group referred to the tornado display when answering the question. For instance, Lourdes wrote, "The tornado was easy because there are holes and if you rub it the tornado goes up." In a similar vein, Ernesto explained,

> Why I say the tornado it is because if you touch it dissappeared and there are some hole in the side.Then what you did was you rubbed it fast and then it build up by it's self by rubbing it.

During interviews, students were asked what they learned. Every student specifically referred to a display and proceeded to explain how it worked.

The third category to emerge from analysis of the data involved the development of scientific thinking strategies like hypothesizing, predicting, inferring, and analyzing. From the critiquing group, Lourdes clearly expressed this idea when she said, "In the disappearing glass scientist know that the glass is one because the water does something when it is inside, but when you put it outside you see six. When you put the rods in the water it reflex by the light." While Lourdes still lacks a complete understanding of the science underlying the display, she seems to have developed the ability to take on the perspective of a scientist. In reference to the lightning globe, Cristina predicts, "How it works is when you put your fingers in the globe all the electricity gows on you." Both groups equally incorporated scientific thinking into the responses to the prompt.

The categories coded support the central phenomenon of motivation, in this particular case through the use of technology in a broad sense. The context is the same as described above. Namely students developed a sense of belonging in a museum setting and had hands-on activities available for their individual use. In addition, students had time to play with the display artifacts. As aforementioned, conditions were conducive to a positive learning environment. These included student experience in a museum setting with expert docents and an experienced teacher, a sense of freedom of choice, and finally prior experience with digital recorders. Emergent strategies include access to exhibits that allow students to construct their own knowledge, particularly exhibits that promote investigative thinking by presenting a discrepant event or an unusual illusion that is rooted in a science explanation. Curiosity is clearly piqued when a display appears different than you might expect. Many students commented on the curious nature of the lightning globe by wondering how an electrical discharge can follow a hand placed externally on a glass globe. Likewise students were prompted to predict why the tornado breaks apart and reforms when a hand is placed in the midst of its swirling air.

## Question: How Does Motivation Impact Knowledge Acquisition?

Once again, it is important to note that the two causal conditions identified in this study were novel use of digital recorders and engagement with hands-on exhibits. Given the context of an established sense of belonging in a museum setting on the part of the students and a significant allotment of time to wander at will in the museum while completing the assigned task, it was clear that a condition of student motivation was present. The data shows that students did gain knowledge in the content area of science. This was indicated by both the worksheet group and the critiquing group through an analysis of the worksheets, transcripts from recordings, and content assessment.

The worksheets completed by the first group as they moved through the exhibit, were reviewed for both understanding of how each display worked and for comprehension of why each worked as they did from a science perspective. In all cases, a majority of students showed a full understanding of how each display operated. They were able to explain in writing how the exhibit components were supposed to be manipulated. For instance, Magdalena, from the worksheet group, responded *to How does the mirror work?* by writing, "You are supost to stand on the corner and it will look like you are flying." Her response details the workings of the display. When asked to dig a little deeper, *Why are there 2 mirrors?* Magdalena added, "There are 2 mirrors to show your reflection and to be able to see yourself." She has identified the property of reflection in her attempt to decipher the *why* component of the display. Although her response does not indicate whether or not she has a full understanding of the underlying science behind the display, she at least has shown she has, at minimum, a partial understanding of the *why* aspect. Joel, when asked *What happens when you move your hand into the tornado?* responds, "The tornado stops and starts again." He can simply describe what happens. His reply to *Why does the tornado move this way?* was, "The air make an air-vortex that make the wind spin that makes a tornado." Joel is incorporating scientific terminology, *vortex*, to describe the wind movement. While the term came directly from the plaque at the display, it is obvious from transcript review that Joel understood the meaning of the word. He interacted with the tornado and observed the whirling shape with the central cavity- a shape that characterizes a vortex. Again, it's suggested that the hands-on experience enhances the academic understanding. The kinesthetic component meshes with the visual information displayed at the exhibit. This offers reinforced learning opportunities. Mariela responds to the question, *How does the mirror work?* in this manner, "So you have to stand on the footprint on your left. Then there's a mirror in front of you and you see fly." Mariela understands the mechanics of the display. Her response to the *why* question for this display shows that she comprehends the underlying concept, that of reflection, when she says, "There one big mirror and one short. How it works the small mirror will reflect anything you to the big mirror." It's not clear as to whether or not she understands the reflection pattern or the fact that light rays are reflecting, however; her general assertion that the process through which an image is produced is reflection is a simple concept that could be expanded and built upon with further instruction. She has the foundation set for knowledge construction.

The critiquing group was given the following instruction regarding the task to critique the exhibits:

*Visit each of the exhibits listed below. You may visit the exhibits in any order. Read the directions found at the exhibit, try the exhibit, and then read the "What's going on?" section. Use your digital recorders to record your comments and ideas about the exhibit. You may talk about the following:*

- *how the exhibit works*
- *what you think about the exhibit*
- *any other thoughts you have while visiting the exhibit*

Some students focused on one aspect of the instructions. Ernesto, for example, seemed most concerned with ensuring that he traveled to each exhibit quickly. An excerpt from his recording transcript shows his focus on rapid movement through the exhibit hall, "We are entering the science museum. Tornado. Right now we're in the tornado. Right now I don't know what's touch the spring, but I'm going to find out what it is. Now we're in disappearing glass rods." The transcript continues with a list of displays visited. There is little description of how or why a display functions in a particular way. Towards the end of Ernesto's recording, he reviews each exhibit, but only in a manner which allows him to express his opinion of the exhibit and a little about the function. For instance, he says, "The tornado, quite cool, it reforms and unforms. The anti-gravity mirror is kind of cool because it looks like you're flying." Ernesto's descriptions are condensed, but they suggest that he was intaking information and forming opinions. The transcripts may not fully show his newly acquired knowledge nor his ability to construct knowledge from interaction with the displays. They do, however, suggest that he was engaging with the displays. His frequent use of the descriptor "cool" indicates that he was enjoying the experience. Manuel's recordings suggest a discovery experience occurs when visiting some displays. When Manuel visited the *touch* *the spring* exhibit he responded in this manner, "Oh my God. Poke it. It's not a spring. Whoa, that hurt. I know. It hits the real spring, then it hits the image, then it makes it back to the spring, then it keeps on going back and forth. Right here." He is clearly constructing his own knowledge because of his experience with the hands-on displays. Because the instructions for the critiquing activity were more open-ended than the worksheet activity, the range of responses was greater. Some students, like Manuel, expressed a developing understanding of the science behind the displays. Others didn't record as much detail and therefore did not show the depth of their understanding.

In essence, for both the worksheet group and the critiquing group, at least a burgeoning display of knowledge acquisition was demonstrated through worksheet and recorder transcripts. There was no substantial difference between the demonstrated amount of knowledge acquisition between the groups.

In addition to the worksheets and transcripts, as previously mentioned, both groups took a content knowledge assessment given in the form of a writing prompt (see Appendix E). Students were asked to explain how science can help develop an understanding of exhibits that seem like magic. The directions indicated that responses should include descriptions of displays seen at the museum to support ideas. As Josef from the worksheet group stated,

> The exhibits I saw look like magic but they are only like expirements. In the exhibits disappearing glass rods, the rod that you could see was made out of flint. The one's you couldn't see where made out of pyrex.

Josef recalled, and seemed to understand, that the two materials, flint glass and Pyrex, were visible and invisible respectively because they were compositionally dissimilar. While Josef does not mention the property of refraction, he does realize that they are viewed differently because of their properties. This is a focal point at the disappearing glass rods exhibit. Magdalena, also from the worksheet group, explained the *touch the spring* display in great detail. She also included a diagram, as aforementioned. Her response was as follows,

> How this works is that in the bottom theres a mirror and a flashlight is hitting the other mirror in the other side. And where the 2nd mirror is there is the real spring in front of it. So when you try to touch the spring you can't.

Magdalena's response suggests that she understands there is a real object present, there are mirrors that reflect light, and an image is produced. This knowledge represents a foundational comprehension of the concept of reflection. Although spelled incorrectly, Magdalena even uses the term, "reflex," in her diagram. Another student, Roberto, referenced the *lightning globe* display in his response, "The lightning globe follows your hand because people have electric charges." Again, this was a point of focus at the exhibit itself, and the student clearly understood.

The critique group expressed knowledge acquisition in a similar way. For example, Luis responded as follows, " I really liked the lightning globe because when you touched it the electricity cam to you like if you were magnetic. I think it did that because I have a liquid in me and water conducts electricity." Luis, in his own way, is expressing an understanding that he, a person composed largely of water, is a good conductor of electricity. Ana discussed the beam bridge in her response to the query. She wrote,

> The beam bridge was 2 wood blocks that were in different ways. One of them is straight and one is flat and when you jump on the straight one it does not move, but if you jump on the flat one it is really jumpy. I think the straight one does not move because it is hard. The flat one might move because it is more flexible and more soft.

Ana's response leans heavily on the information offered at the display plaque; however, she adds her own speculation regarding the difference between the wood beams. She builds on her recollection of the exhibit.

The data undoubtedly shows that students were motivated to learn. Knowledge acquisition is difficult to assess. Assessment is reliant on the students' willingness and ability to demonstrate their acquired knowledge. Because students were asked to refer specifically to their museum experience, the impact of the exhibit activity became more lucid. Students were able to recall their museum experience and could write about it. This suggests that they were able to construct their own knowledge, and as Carlson (1998) suggested, children involved in hands-on activities, those that they perceive to be fun and offer little in the way of extrinsic motivation, will learn by doing. Curiosity and interest determine how a student will vest their psychic attention. Clearly the students involved in this study were interested enough to direct their attention to the exhibits. This resulted in knowledge acquisition. Perhaps more importantly, students were intrigued enough to be able to draw on their knowledge several days after the exhibit activity. While the information relayed by the students was foundational, the concepts presented are the same ones that will be studied in greater depth as a part of the curriculum detailed by the state of California where these students reside. It is crucial for students to have well-developed baseline knowledge on which they may build more in-depth understandings.

## SUMMARY

Both methods of instruction, worksheet and critiquing activity, had equal value in terms of fostering motivation. It was expected that the latter activity might foster more motivation, but because the novel use of digital recorders and the opportunity for engagement with hands-on displays took precedence in terms of motivation, the differentiation that was anticipated between the worksheet and critiquing activity was not discernable. The term *technology* was used in a broad sense for this study, and was considered to be a way of completing a task using technical processes or methods. The exhibit displays used in this study would be considered technology-enhanced using this broad definition. Such displays, those incorporating hands-on components, intrigued students, inspired speculation and hypothesizing, and sparked intrinsic motivation. Students wanted to know more. Analysis of the worksheets, transcripts, and the modified version of WebMAC Junior 2000, all point to high levels of motivation on the part of students. When learners are intrinsically motivated and involved in a particular activity, they typically call upon the cognitive processes which ultimately arouse the desire to seek out information (Carlson, 1998). Students participating in this study were diligent when it came to seeking out information. As the classroom teacher expressed, "The museum program opens up another world. Without it, some kids would never leave their neighborhood."

# CHAPTER 5

# DISCUSSION

## SUMMARY

The intent of this study was to cultivate an understanding of student motivation in a museum setting. Students from a pre-existing program, School-in-the-Park, were selected to participate because of their unique experience as museum learners. Two methods of learning were employed as students were allowed to traverse the floor of the ExploraZone 4 exhibit. One method was designed to emulate a traditional fieldtrip lesson. Specifically, students were required to complete a worksheet that would guide them from display to display. The other method of learning was developed with the construct of flow as an underpinning.

A state of flow is marked by several distinct characteristics (Csikszentmihalyi, 1975). First, a person experiencing flow has focused, undivided attention placed on the activity of engagement. Second, the activity must be challenging enough to cause an individual to stretch mentally or physically, but not so much as to cause anxiety. Third, an individual must receive immediate feedback, be able to react automatically, and therefore, feel in control of the situation. Such engagement results in a feeling of enjoyment. Given this criterion, the second method of instruction required that students critique the museum displays by recording, thoughts, ideas, and general commentary using digital recorders.

The activity design was intended to offer immediate feedback by allowing students to record their voices- they instantly knew they were completing the task by expressing thoughts into the recording device. It was anticipated that students would be wholly focused on delivering their ideas, in a manner that was ambitious and engaging. Because motivation is a substructure of flow, and motivation may be more facilely observed in a population of 10 and 11 year olds, this study sought to understand the concept of motivation as it relates to the museum learning experience.

What was not anticipated was the degree to which the students would be motivated by the exhibits themselves. In fact, there was no difference between levels of motivation for the worksheet group and the critiquing group. Both groups were highly motivated by the museum lesson. According to Arnone and Small (1999b), functionality and interest level are components of the motivation appraisal of an activity. Both components were highly rated by each group. An examination of transcripts from activities and interviews along with worksheet and assessment data show that the hands-on nature of the exhibits themselves supercedes any other factor of motivation that existed during the museum visit. The students were focused on studying the discrepant and illusionary activities at the displays, and were intent on understanding the displays by physically engaging in the manipulation of materials and artifacts at each station.

Students received immediate feedback when they successfully constructed or participated in a display activity. Students expressed the notion that they felt challenged, but they also unanimously stated that they felt in control of the situation. Clearly, students were motivated and therefore possessed a propensity for experiencing a flow state.

In addition to the expressed interest in the hands-on aspect of the displays, all but one student spoke of enthusiasm for the incorporation of digital recorders into the activity. The critiquing group, in particular, indicated that use of the recorders gave them a sense of importance. They could focus on the activity without concern for the writing aspect that is traditionally associated with a fieldtrip visit. The worksheet group also declared a fascination with the recorders, although the students of this group were primarily concerned with "getting the correct answer" written coherently on the pages of their worksheets.

The students in both groups were comfortable with being in a museum setting and were candid about their willingness to consult with museum experts when confused about a display. Students relished the time to, in their own words, "play" at the exhibits. Perhaps unwittingly, they were engaged in the construction of knowledge as they "played." This was evident as students speculated, hypothesized, and problem-solved in a very natural, unaffected manner at every display.

Students knew how to approach museum learning. They were aware of signage that would provide explanations to the workings of a particular display. They knew that expert personnel could assist when needed. They applauded the time given to wander and choose which exhibit to visit first. They even perceived that they were in control of their learning environment.

The hands-on aspect of the exhibit, as mentioned, was the foundational component of student motivation. For the purpose of this study, a broad definition of technology, one that encompassed a hands-on approach, was employed. Students responded to the technology by incorporating diagrams, explanations, and scientific thought into their assessment responses. This stands as evidence that students were constructing their own knowledge. Students were motivated and analysis of the content assessment shows that they did access a knowledge base that is foundational to standards-based learning. Students were discussing content by infusing vocabulary terms like reflection and refraction into explanations that showed their understanding. They were pondering, using expressions like "I wonder" or "Let's try." These are elements of knowledge construction. The results of this study expose the depth of student motivation with hands-on museum engagement. From this, strategies for instruction and learning may be extracted to help enhance the museum experience for both educators and students alike.

## CONSTRUCTING KNOWLEDGE

As the process of open coding progressed in the data analysis portion of this study, it became apparent that two categories took precedence: knowledge acquisition and hands-on participation. Axial coding further focused the data review on the overarching theme of motivation. This became the central phenomenon that was further explored. The fact that these students had several years of prior experience with learning in a museum setting was central to the development of a sense of belonging in the museum. The museum was more than just a place to visit. It had become a familiar classroom that students had made their own. They knew where to look for clarification and felt at ease with manipulating the display artifacts. According to Ms. Andrews, the classroom teacher, "They feel safe. They can make mistakes." This sense of comfort helped create conditions suitable for knowledge construction. As Eiserman (2000) stated, student learning is enhanced when museums offer comfort, community, and conversation to visitors. The SITP experience has clearly provided students with numerous opportunities to develop a feeling of ease in a now familiar setting. Students have collaborated for an amount of time that has allowed them to establish a learning community. In addition, transcripts from digital recordings manifest the significance of conversation to the learning process for these young people. Hein (1995) described what he referred to as the constructivist museum. Such a museum would provide the opportunities for visitors to connect with familiar concepts and objects, thus connecting prior knowledge with new experiences. According to Hein, constructivism presents the notion that both knowledge and the way it is obtained are dependent on the mind of the learner. The ExploraZone 4 exhibit supported knowledge acquisition in a contructivist format. The students visiting ExploraZone 4 manipulated objects that were familiar but were set in a novel situation. For instance, they viewed an image of a spring that was reflected from a mirror. The spring and mirror were familiar objects, yet the positioning of each created an image that was surprising and unexpected. This twist on familiar materials fostered curiosity and critical thinking. Students began to problem-solve and were inspired to look at the plaques for explanation.

Moore (1997) in her discussion of postmodernism museum education, suggested that a paradigm shift has occurred in the realm of museum education- one that fosters aesthetic appreciation for all viewers, not just for the elite. While Moore's primary focus centered on art museums, she speculated about other types of museums like science museums. Observations of the subjects of this study, students from a low-socioeconomic community, indicate that Moore's findings may be extended to include science museums. According to Moore, postmodernist museum educators are concerned with pedagogical approaches that serve a cultural critique and encourage students to develop a sense of connection between themselves, the museum objects, and the world in general. The ExploraZone 4 exhibit may, in some ways, act as a postmodernist mechanism for connecting all visitors to their world through paradoxes and discrepancy. As suggested by Taylor (1990), a thriving museum education program will offer a museum educator as facilitator rather than as information authority. Both methods of learning involved in this study gave students the opportunity to learn from the exhibits themselves. Museum personnel acted as peripheral support. The experience for both groups was clearly student-centered. This may have been a factor contributing to high student motivation.

Sandifer (2003), when looking at technological novelty in a museum setting, described the common characteristics that kept visitor attention at a high baseline value. He noted a high degree of interactivity, clarity of instructions, an intuitive user interface, and appropriate feedback in the form of immediate effects that result from visitors' interactions. The ExploraZone 4 exhibits were completely hands-on in nature so interactivity was a mainstay of a visitor's tour of this museum. When asked about clarity of instructions, students agreed that all posted signage was relatively easy to comprehend. In addition, students were offered immediate feedback as they manipulated objects in a successful manner. The relevant characteristics of high attention were present thus supporting the inclination for intrinsic motivation on the part of the students. Students were motivated to learn content and to construct knowledge.

## Feelings of Comfort and Familiarity

The most intriguing aspect of this study centered on the feelings of comfort and familiarity expressed by the students. On several occasions, students spoke of bringing family members to the museums that have been a part of the SITP program. They took on a sense of ownership and pride, and seemed to be willing to "show off" their connections with these places of cultural and scientific learning. This established sense of comfort seemed to contribute to the propensity for intrinsic motivation. Students had a vested interest in learning about their frequent dwelling place. The barriers of unfamiliarity had been broken down and anxiety was reduced. This created a climate where learning could occur.

While content knowledge was definitively acquired, interviews with students imply that more than merely factual and conceptual knowledge was constructed. Students also advanced a knowledge base that included the development of scientific processing skills. More specifically, they practiced predicting, hypothesizing, analyzing, and synthesizing information. These are translatable skills that may be used in numerous real-world situations. Such acquisitions are foundational to the development of critical and creative thinking- the hallmarks of science.

In addition, these students, who are from a community where the high school dropout rate is approximately 30%, were articulating an enthusiasm for learning. In order for students to become intrinsically motivated to learn, they must be interested and motivated (Dewey, 1913). The students participating in this study were enthused about SITP. They unanimously stated that SITP should be part of the curriculum. During interviews conducted on the traditional school campus, it became evident that the excitement for school generated in the museum setting, carried over into the traditional classroom. Ms. Andrews, the participants' teacher, markedly stated, "These students are different." They've had the opportunity to experience a rich learning environment that is unavailable to most children. Ms. Andrews added, "It opens another world. It shows them there's more to life. The content comes alive. You have realia! You have real minerals!"

## Discussion

A substantive theory of student motivation has been derived from analysis of the categories that emerged from the coding process. Specifically, students visiting museums are motivated through hands-on activities that allow them to physically engage with artifacts. While this concept is firmly established in the literature (Csikszentmihalyi & Hermanson, 1995; Hein, 1998; Dierking & Falk, 2000), the impact of long-term exposure to a familiar museum environment is in need of further exploration. This study suggests that, for museum exposure to have a deep and lasting effect on students, it may be necessary to offer students the opportunity to experience a particular museum environment on a repeated and regular basis. The SITP students had years of experience visiting the museums and working with museum personnel. They were, in fact, experts at seeking out information from museum resources. Their critical thinking skills were honed and most strikingly, they expressed a desire to learn and seemed to recognize that it was their right and privilege to be a recipient of an education. Dierking and Falk (1998) determined that most American museum-goers consider education to be an important life-long endeavor. Perhaps the long-term museum learning opportunity which the students involved in this study have had, has translated into feelings that parallel those of traditional museum-goers- more specifically, the sense that education is an imperative, life-long pursuit. This is a phenomenon that is so pervasive throughout this particular class of students, that consideration should be given to the possibility that it may be attributed in great part to this rare opportunity of repeated museum exposure. There is a great need in school communities across our country to provide opportunities for motivation. The students observed in this study were inspired by more than just the usual stock of extrinsic motivators- grades, rewards, or praise. They were curious, inquiring, and enthusiastic- all qualities that signify intrinsic motivation. If we are to combat the high dropout rates that pervade the statistical documents found in many cities across the country, we need to find ways to generate a desire and a reason for our young people to learn and pursue education. This research suggests that one solution may lie in providing repeated opportunities for young people to visit museums.

In large cities in particular, there are numerous museums- art, historical, natural history, aerospace, zoos, and aquariums. Many of these locales host traveling exhibits so students visiting the museums may have the opportunity to see different exhibits during various visits. In addition, students could be asked to explore a particular exhibit in different ways from year to year. For instance, during one visit, they might be asked to explain the function or meaning of an exhibit. Another time, they might be asked to study an exhibit so that they may create their own version with modifications. Opportunities for learning abound, and further research is clearly warranted.

Such opportunities could be expanded to include other types of field excursions such as visiting tide pools for those in coastal regions or trips to pine forests for those in colder climes. Once again, this study suggests that repeated and frequent visits help to establish a sense of familiarity and belonging. In addition, a certain expertise is ascertained from frequent visitation. This supports intrinsic motivation and a positive outlook on school.

One intention of this study was to look at motivation as it relates to student activity during the museum visit. The data showed that the type of activity, critiquing or worksheet completion, had no effect on motivation. In fact, both groups, the worksheet group and the critiquing group, were highly motivated by their respective museum engagement. Further examination of the effect of museum activity suggests that the critiquing activity may have benefited from being novel, while the worksheet activity may have had the advantage of being specifically and carefully tied to particular exhibits in a clear and coherent manner. In fact, the worksheet was created by a teacher, pre-tested by a fifth grader, and then revised to enhance clarity. Students were asked to focus on both understandings of function and science meaning as they responded to questions. Because the questions were tailored to the exhibits specifically and because questions asked students to think critically, the worksheet may have pointedly inspired confidence and motivation. While students were fascinated with the digital recorders, they didn't express a definitive desire to either critique the exhibit or to complete a worksheet. Instead, they seemed most captivated by the content presented at the exhibit itself. Clearly mode of learning was not as critical as was the nature of the exhibit.

## Suggestions for Future Research

The findings of this study suggest that students may benefit from repeated visits to museums or places of informal learning. While this recommendation could be effectively put into place in many communities, such programs could benefit from additional research in several areas.

For instance, if students are to construct in-depth knowledge developed over the course of many visits to an exhibit, then teachers must have the skill and ability to vary the types of activities in which students will participate. Offerings must be designed to allow students to probe a display or examine an artifact in a manner that progressively fosters higher order thinking skills. Further study in this area could ultimately result in an effective protocol for museum engagement that fosters a progression towards synthesis and analysis on the part of students.

This study also indicates that there is a need for research that could support an understanding of how digital recording devices could be best employed by students examining an exhibit. Students enjoyed using this technology; however, a more explicit awareness of the means by which students could have a more meaningful experience while using the recorders, is needed. What type of information should be recorded? How should teachers direct students to use the recorders? Should instructions be given in written form or in recorded form? Is the duration of the activities significant? Should students work in pairs, teams, or should a recording activity be a solo endeavor? Answers to all these questions are needed to ensure a rich learning opportunity for students.

The students involved in this study had an established familiarity with museums. They knew where to seek out support and how to ask questions. This comfort with the environment engendered a sense of belonging and thus reduced the anxiety that others, less familiar with such a setting, could experience. Further research could help develop an understanding of how long it takes to foster such a feeling of ease. Other related issues beg to be examined as well. What role does a sense of comfort play in regards to knowledge construction? How can the teacher support a sense of belonging on the part of students? Is there a correlation between familiarity and expertise? The students in this study had experienced museum learning for several years. How would the data look if the same study were conducted with students with no museum experience- in essence, typical fifth graders? A parallel study might involve student visits to a museum that is not as inherently interesting, with less of a hands-on component.

Because informal learning environments allow students to experience aspects of the world beyond the usual brick and mortar of their local learning establishment, educators are in need of insightful information to guide efforts to fruitfully tap into such learning resources. In-depth, focused research may help to clarify the implications of this study. In addition, it is hoped that researchers will examine other schools with extensive museum visitation programs to verify the patterns revealed by this study.

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# APPENDIX A

# MODIFIED WEBMAC JUNIOR 2000 SURVEY

*Modified Version of WebMAC Junior 2000*

(original version developed by Arnone, M. P., & Small, R. V., 1999)

Name:______________________________School:______________________________

Grade: ______________________________ Date: ______________________________

Exhibit: ______________________________

**Instructions**

Just like the judges who decide the winners in an art or science contest, you are one of the judges for this museum exhibit. After reading each question, circle the face that best describes how you would rate this exhibit. Remember that there are no right or wrong answers. First, try the example below.

**Example**

Did this exhibit contain things that your are interested in?

0 1 2 3

If you circle the sad face, it means the exhibit is really poor in this category. There is nothing in the exhibit that is of interest to you. You give it the lowest score, which is 0 points.

If you circle the face with no expression (just a straight line for a mouth), it means the exhibit is OK, but there is nothing special that interests you.

If you circle the face with a small smile, it means the exhibit is not the best, but it is good.

If you circle the face with a big smile, it means that the exhibit is one of the best you've seen when it comes to things that interest you. You give it 3 points, the highest score.

1. Is this an interesting or fun exhibit to explore?

0 1 2 3

2. Can you read and understand most of words that are used as a part of the exhibit?

0 1 2 3

3. Is the information at this exhibit believable? (Does it seem to be true?)

0 1 2 3

4. Is it easy to find your way around the exhibit without getting lost?

0 1 2 3

5. Do the pictures, sound, or other audio-visuals make this exhibit more interesting?

0 1 2 3

6. Is it easy to find what you need at this exhibit?

0 1 2 3

7. Does this exhibit have connections to topics that are of interest to you?

0 1 2 3

8. Do all the parts of this exhibit work the way they should?

0 1 2 3

9. Are there lots of activities to do at this exhibit?

0 1 2 3

10. Are the directions for exploring this exhibit clear and simple?

0 1 2 3

11. Do you think this exhibit might add new things to read about and do in the future?

0 1 2 3

12. Are the hands-on activities working quickly and easily?

0 1 2 3

13. Do you like the way this exhibit looks?

0 1 2 3

14. Can you find enough of what you are looking for at this exhibit?

0 1 2 3

15. Is what you are finding at this exhibit useful to you?

16. Are there ways of getting help if you need it at this exhibit?

0 1 2 3

Would you like to visit this exhibit again sometime (√) YES □ NO □

Is this an exhibit that friends your age would like to visit? YES □ NO □

What do you like best about this exhibit? Write in the space below.

____________________________________________________________

____________________________________________________________

What would make this exhibit better? Write your ideas below.

____________________________________________________________

# APPENDIX B

# WORKSHEET

Name:______________________________ Date:_______________ Age:_________

**ExploraZone**

**Directions:** Go to each of the exhibits described below. Read the directions found at the exhibit, try the exhibit, and then read the "What's going on?" section. Answer the question(s) below.

**Anti-Gravity Mirror:**

1) How does this mirror work?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

2) Why are there 2 mirrors?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**Tornado:**

3) What happens when you move your hand into the tornado?

4) Why does the tornado move this way?

**Touch the Spring:**

5) Why does your hand go through the image of the spring?

**Disappearing Glass Rods:**

6) Why do you see only 1 rod in the liquid?

7) Describe how the picture looks through the lens in the liquid and how it looks through the air (above the liquid)?

**Beam Bridge:**

8) Why does the outer beam sag more than the inner beam?

**Caternary Arch: (When you set this up, be sure the black stripes on the sides of the blocks are inside the arch.)**

9. Explain how the arch is supported?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**Lightning Globe:**

10. What happens when you place your hand on the globe?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

11. How is the lightning globe like the sun?

______________________________________________

______________________________________________

**Braceable Bridge**

12. What happens when you bounce on the bridge with the sideboards down?

13. What happens when you bounce on the bridge with the sideboards up?

14. Can you explain why there is a difference?

# APPENDIX C

# INTERVIEW PROTOCOL

Interview Protocol

Name:______________________________ School:______________________________

Grade: ______________________________ Date: ______________________________

Exhibit: ______________________________

1. What do you think about this exhibit?
2. How did you feel while completing the assignment?
3. Were the instructions clear?
4. Did you feel confident/sure about what you were doing today? Did you feel like you were in control?
5. What did you learn today?
6. Was this assignment different or similar to activities you've done before?
7. Would you like to do a similar assignment on another day? Could you elaborate/explain your thoughts?
8. Is there anything else you'd like me to know about your experience today?

# APPENDIX D

## SCORE SHEET

Individual Scoring Sheet

**Instructions:** Have your WebMAC Junior 2000 with your filled in responses beside you. Using this scoring sheet, copy the score for each question next to the number of that question. Notice that odd-numbered questions are under column A and even-numbered questions are under column B. Then add up the scores for each column.

| A | B |
|---|---|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |
| 5. _____ | 6. _____ |
| 7. _____ | 8. _____ |
| 9. _____ | 10. _____ |
| 11. _____ | 12. _____ |
| 13. _____ | 14. _____ |
| 15. _____ | 16. _____ |
| | |
| Total A: _____ | Total B: _____ |

# APPENDIX E

# WRITING PROMPT

**What Have You Learned?**

**Name:**______________________________ **Date:**_____________ **Age:**__________

**Directions:** You have recently visited ExploraZone 4 at the Ruben H. Fleet Science Center. Many of the exhibits you saw at first may have seemed like magic. Using the knowledge you gained from your visit to ExploraZone 4, explain how science can help us understand exhibits that may seem like magic. Use examples or descriptions of exhibits you saw to support your ideas. Remember you saw the following exhibits:

Anti-Gravity Mirror

Tornado

Touch the Spring

Disappearing Glass Rods

Beam Bridge

Caternary Arch

Lightning Globe

Braceable Bridge