CHAPTER 2
Review of the Literature

Introduction

Calls for the reform of education, particular in science education, are growing and often strident. Many reformers advocate a move away from teacher-center towards student-center learning (Smerdon; Burkam ; &Lee. 1999: 6). The resistance to change from those in authority within the educational culture has often been strong. Nevertheless, the revolution has progressed steadily and there is evidence, of widespread acceptance of constructivism (Tobin. 1993: 3). In addition human resource development has become a central feature of most national development strategies. Within this very important process is the need for a constant development of life-long learning to ensure sustained successes in life (IPST. 2004: Online). Lifelong learning is the integrated scope of education which covers the formal, non-formal and informal education (The nation. 2000: Online). Thus in Thailand, with the 1999 education act, the government is determined to launch educational reforms with the aim of developing Thailand into a knowledge-based society. The reform provides the Thai public with equal access to lifelong education (Ministry of foreign affair. 2000: Online).

The culture of life-long learning needs to be reinforced as it opens up many more avenues and opportunities for members of society. Nevertheless, lifelong learning in Thailand, in the past, concerning formal, non-formal and informal education, has encountered major obstacles such as - education opportunities not being allocated equally; the present education system does not aid under-represented groups; and the content was not practical in real life. People were negligent concerning lifelong learning as well as lacking the motivation and needed support systems; the community received insufficient participation on lifelong learning activities due to the misconception that education was only provided in schools (The Nation. 2000: Online). Toward this end, in this study I developed the constructivist thematic science program at Chiangmai zoo based on constructivism. The purpose was to link formal and informal science education and provided a teaching-learning program for level three students in the informal setting at the Chiangmai zoo.

This chapter is a review of the available literature dealing specifically with:

1. National education act B.E. 2542 (1999) and amendments (second national education act B.E. 2545 (2002)
2. Science education in Thailand
3. Constructivism: an underpinning philosophy of science education reform
4. The thematic approach to science learning
5. Informal science education
6. Education at zoos
7. Chiangmai zoo

1. National education act B.E. 2542 (1999) and amendments (second national education act B.E. 2545 (2002)

Thailand's current education reform (1999) initiates steams from the shock of the Asian economic crisis. Thus, Thailand as part of its strategic path of economic discovery, initiated new education reforms. Another attempt at this education reform emphasized Thailand's need to adapt to the challenger of globalization and internationalization. The basic premise was that, for Thailand to be internationally competitive, it needs to internationalize Thailand's educational system to prepare Thai young people for and increasingly intercultural global era (Fry. 2002: 3).

With the national education act B.E. 2542 (1999) and amendments (second national education act B.E. 2545 (2002), there is a shift in the philosophical underpinning. The key motifs of the education reform are stated in section 4 of the act "Education means the learning process of personal and social development through imparting of knowledge… by creating a learning environment and a learning society and the availability of factors conductive to continuous lifelong learning." (Office of the national education commission. 2003: 10).

From the promulgation as stated in section 4, it is advocated, as in other recent reform in many countries, that these recent education reforms move away from teacher-center, direct instruction towards student-centered, understanding-base teaching. This student-center, student-active instruction is often called constructivism (Smerdon; Burkam; &Lee. 1999: 6). The main ideas about constructivism are suggested for reformers shown in section 22 (Office of the national education commission. 2003: 10-12) “Education shall be based on the principle that all learners are capable of learning and self-development... The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potentiality”. Subsequently, the national education acts also provide a starting point for informal education as stated in sections 23, 24 and 25 (Office of the national education commission. 2003: 10-12).

Section 23: Education through formal, non-formal, and informal approaches shall give emphases to knowledge, morality, learning process… scientific and technological knowledge and skills, as well as knowledge, understanding and experience in management, conservation, and utilization of natural resources and the environment in a balanced and sustainable manner.

Section 24: In organizing the learning process, educational institutions and agencies concerned shall: enable instructors to create the ambiance, environment, instructional media, and facilities for learners to learn and be well-rounded persons. In so doing, both learners and teachers may learn together from different types of teaching-learning media and other sources of knowledge; enable individuals to learn at all times and in all places. Co-operation with parents, guardians, and all parties concerned in the community shall be sought.

Section 25: The State shall promote the running and establishment, in sufficient number and with efficient functioning, of all types of lifelong learning sources, namely: public libraries, museums, art galleries, zoological gardens.

The national education act lays down guidelines for the provision of education, management of the learning process, and preparation of educational curricula at various levels. Recognizing the urgent need for education reform, the government, acting through the office of the national education commission (ONEC), has formulated policies and plans to bring about the necessary changes within the Thai educational system. Thus, the result of these provisions is the basic education curriculum B.E. 2544 (A.D. 2001) (The nation. 1999: online).

The basic education curriculum aims to produce learners who are good persons, possess knowledge and capability, and enjoy learning. The learning contents are classified into eight subject groups, namely:

1. Thai language

2. Mathematics
3. Science and technology
4. Social studies, religions and culture
5. Health and physical education
6. Visual arts, music and performing arts
7. Work and vocation
8. Foreign languages

Science is the principal subject group in the basic education curriculum of AD 2001. Curriculum, instruction and assessment all have to be considered in laying the foundation for science education of the learners at all levels. (IPST. 2001: Online).

2. Science education in Thailand

Incorporate with nation education act above, science education in Thailand also has undergone change. Visions for science learning, provided by the institute for the promotion of teaching science and technology (IPST), that in compliance with basic education curriculum are the following (IPST. 2001: Online):

- Learning of science should be a developmental process so that the learner acquires proper knowledge, process, and attitude.
- Science learning should be a lifelong process
- Basic science learning is for greater understanding, better appreciation of nature and the environment.

In reviewing the national science curriculum standards (the basic education curriculum B.E.2544), it was found that science education has two board purposes. The first purpose is to promote scientific literacy among Thai citizenship on matters directly affecting their own lives and the society so that they can make decision based on information and understanding. The second purpose is to build up the technological capacity by equipping the future workforce with essential science-based knowledge and skills and by preparing students for scientific disciplines in higher education and science-related careers. Given the potential benefits, the provision of quality science education to all children will have far reaching consequences on a country's development prospect (Musar; 1993: 3). Reforms also advocate use of the scientific process skills and as the basis for hands on science activities. Moreover practical activities in science education are regarded as one of the necessary elements to promote science, attitude toward science and a scientific attitude.

2.1 Science process skills

Science process skills are a means for learning and are essential to the conduct of science (Holt: & Winston. 2006: online). According to the curriculum project, science - a process approach (SAPA), these skills are defined as a set of broadly transferable abilities, appropriate to many science disciplines and reflective of the behavior of scientists. SAPA grouped process skills into two types-basic and integrated. The basic (simpler) process skills provide a foundation for learning the integrated (more complex) skills (Padilla. 1990: online). These skills are listed and described below (AAAS. 2006: Online).

2.1.1 Basic skills

2.1.1.1 Observing: using the 5 senses (see, hear, touch, smell, taste) to find out about objects and events, their characteristics, properties, differences, similarities, and change.

2.1.1.2 Classifying: grouping or ordering objects or events according to similarities or differences in properties.

2.1.1.3 Measuring: comparing an unknown quantity with a known (metric units, time, student- generated frames of reference)

2.1.1.4 Inferring: interpreting or explaining observations.

2.1.1.5 Predicting: forming an idea of an expected result, not a guess, but a belief of what will occur based upon present knowledge and understandings, observations and inferences.

2.1.1.6 Communicating: using the written and spoken work, graphs, demonstrations, drawings, diagrams, or tables to transmit information and ideas to others.

2.1.1.7 Using number relationships: applying numbers and their mathematical relationships to make decisions.

2.1.2 Integrated skills

2.1.2.1 Making models: constructing mental, verbal, or physical representations of ideas, objects, or events to clarify explanations or demonstrate relationships.

2.1.2.2 Defining operationally: creating a definition by describing what is done and observed.

2.1.2.3 Collecting data: gathering and recording information about observations and measurements in a systematic way.

2.1.2.4 Interpreting data: organizing, analyzing, and synthesizing data using tables, graphs, and diagrams to locate patterns that lead to the construction of inferences, predictions, or hypotheses.

2.1.2.5 Identifying and controlling variables: manipulating one factor to investigate the outcome of an event while other factors are held constant.

2.1.2.6 Formulating hypotheses: making educated guesses based on evidence that can be tested through experimentation.

2.1.2.7 Experimenting: designing one's own experiment to test a hypothesis using procedures to obtain reliable data.

2.2 Scientific attitude

Scientific attitude has come to be known as a way in which scientist believe in and conduct their work (Simson; Koballa; &Olive. 1994: 211). Gardner (1975) mentioned that scientific attitude included the characteristics of scientists that are believed to be desirable in the study of science, such as open-mindedness and objectiveness (Gardner. 1975: 30).

Several reasons have been given for the need to study student science attitudes. For example, it has been said that positive attitudes toward school subjects are important because they: enhance cognitive development; increase the learning of the subject both formally and informally after the direct influence of the teacher has ended; and attitudes are communicated to friends and peers (Mager; 1968: Online). Furthermore, it is important to study attitudes because positive attitudes result in increased enrollment in science courses, and influence science achievement and interest in scientific careers (Shamai. 1996: Online). Also, students with positive attitudes towards learning science are more likely to have intentions to engage in future learning behaviors (Norwich & Duncan. 1990: 312-321).

2.3 Attitude toward science

Attitude towards science or feelings toward science refers to a person's positive or negative response to the enterprise of science. In addition, it refers specifically to whether a person likes or dislikes science. Simpson & Troost (1982) and Simpson & Oliver (1990) designed a seven-item subscale to measure students' attitude toward science as follows:

1. Science is fun.
2. I have good feeling toward science.
3. I enjoy science courses.
4. I really like science.
5. I would enjoy being a scientist.
6. I think scientists are neat persons.
7. Everyone should learn about science

Research into various aspects of attitude towards science has contributed a significant amount of literature throughout the past several decades. The studies of attitude have led researchers in science education to the understanding that there are many variables that correlate with attitudes about science such as achievement (Freedman. 1997: 343--357), behavior (Shrigley. 1990: 97-113), and grade level (Simpson & Oliver. 1985: 511-526). Still, another goal for some science educators has been to find ways to foster positive attitude toward science as an attempt to create a more scientifically literate populace (Simpson, Koballa, Oliver, & Crawley, 1994: 211-234)

Summary

The constructivism influence has extended beyond just the research and scholarly community: it has had an impact on a number of national curricular documents and national education statements (Matthews 2002: 121), including the national education act in Thailand. Similarity, in many nations around the globe, science education is currently going through the process of change. It appears that the reform efforts in different countries share some important characteristic, which is are apparently related to constructivism (Van; Beijaard; & Verloop. 2001: 137-158). Today, the objectives of science education are not only the phenomena of nature but are constructs that are advanced by science process skills, scientific attitude and attitude toward science.

3. Constructivism: an underpinning philosophy of science education

The view that knowledge cannot be transmitted but must be constructed by the mental activity of learners, which refers to constructivism, underpins contemporary perspectives on science education (Driver; &et.al. 1994: 5). Constructivism is not new, it has been explained by many scholars including, Jerome Burner, John Dewy, Jean Piaget, Lev Vygotsky, and Ernest Von Glaserfeld.

3.1 Theory of constructivism

3.1.1 Pragmatism constructivism

Jerome Bruner (1915 -)

Bruner's contribution to constructivism was the concept of discovery learning. He found that when students are presented with highly structured materials, they become too dependent on other people and they are likely to think of learning as something done only to earn a reward (Bruner. 1983: 183). In contrast, he mentioned the concept that when children arrive at on their own they are more meaningful than the purpose by others and that students do not need to be rewarded when they seek to make sense some of things. Therefore he suggested that teachers should confront children with problems and help them seek solutions either independently or by engaging in group discussion. So true learning will occur when students figured out how to use what they already know in order to go beyond the way they are already thinking.

Bruner argued that understanding the ways in which ideas connect with one other, the possibility of solving problems on our own, and how we already know is relevant to what we are trying to learn is the purpose of education and can best be achieved through personal discovery (Snowman; & Biehler. 2006: 311).

John Dewey (1859-1952)

For Dewey education depends on action, knowledge and ideas emerged only from a situation in which learners had to draw them out of experience. Then this new experience had a meaning and importance to learners (Dewey. 1966: 151). Furthermore these situations had to occur in a social context, such as a classroom. In classroom students joined in manipulating materials and, thus, created a community for learners who built their knowledge together. Dewey's conception suggested that knowledge and instruction should build on student's experience, rather than be viewed as fixed or determined (Dewey. 1902: 60).

Dewey mentioned there is always some stimulus or goal for learning in a learning environment that he terms as the problematic. The problematic leads to and is the organizer for learning (Dewey. 1938: 20). So the important point here is that the problematic situation of content is central to the learning process in constructivism.

3.1.2 Cognitive constructivism

Jean Piaget (1896-1980)

Piaget's constructivism is based on his view of the psychological development of children. This theory of development states that human beings develop through predicable stages, each of which is typified by the emergence of new cognitive structures that increase in the complexity of thinking (Tam. 2000: 3). These stages are described in TABLE 1.

Piaget described intelligence as how an organism adapts to its environment and it is controlled through mental organizations called schemes that the individuals use to present the designate action. This adaptation is driven by a biological drive to obtain balance between schemes and environment that he called equilibration. There are two processes that individuals use to adapt; assimilation and accommodation. Assimilation is the process of using or transforming the environment so that it can be placed in preexisting cognitive structure. Accommodation is the processes of changing cognitive structures in order to accept something from the environment. Both process are used simultaneously and alternately through life (Huitt; & Hummel. 2003: 1-2) Piaget suggested that educators should understand the steps, in the development of the child's mind, which children have to go through to accept ideas. Therefore in an autonomous activity, children must discover relationships and ideas in classroom situations that involve activities of interest to them.

Piaget's individualistic approach to constructivism epitomized that the learners are central to the learning process. It is the collaboration among learners that make constructivism not and example of solipsism, rather it encourages the construct of social context in which collaboration creates a sense of community (Tam. 2000: 3).

TABLE 1 PIAGET'S STAGE OF COGNITIVE DEVELOPMENT

Age factor	Characteristics
0-2 Years	**Sensorimotor stage**: Acquiring understanding primarily through sensor impression and motor activities; develop and use schemes for mental and physical trial-error behavior.
2-7 Years	**Preoperational stage**: Understanding the centers of the mastery of symbols; also use of imitation.
7-11 Years	**Concrete operational Stage**: Capable of mentally reversing actions; operational thinking is limited to objects that are actually present or directly experienced; mastery of conservation (ability to recognize that properties stay, despite change in appearance) of numbers, space, continuous quality and substance.
11+ Years	**Formal operational Stage**: Able to read with abstraction form, hypotheses; solve problems systematically, and engage in mental manipulation

3.1.3 Social constructivism

Ly Vygotsky (1896-1934)

Vygotsky's work has formed the foundation of social constructivism in educational setting. His emphasis is on the role of the other, or the social context. According to Vygotsky, learning is best understood in light of others within an individual's world. He described it as the zone of proximal development (ZPD). He defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (Vygotsky; 1978: 86).

Vygotsky thus attempted to ascertain the difference between what a child could achieve by themselves (their actual level of development), and what they could achieve with assistance (their level of potential development) (Rogoff; & Wertsch. 1984: 2). The ZPD is then defined as the intellectual potential of an individual when provided with assistance from a knowledgeable adult or a more advanced child. Therefore Vygotsky felt good instruction could be provided by determining where each child is in his or her development and building on that child's experience (Tam. 2000: 3).

3.1.4 Radical constructivism

Ernst von Glasersfeld (1917-)

Ernst von Glasersfeld is one of the leading advocates of a radical version of constructivism both as a theory of knowledge and as a guide for science education. He believed that knowledge is something personally constructed by individuals in an active way. It is the results of an individual subject's constructive activity, not a commodity that somehow resides outside the knower and can be conveyed or instilled by diligent perception or linguistic communication (Boudourides. 2003: 11). Staver criticizes von Lagerfeld's work into four principles which describe knowing and knowledge in their development, nature, function, and purpose:

1. Knowledge is actively built up from within by a thinking person; knowledge is not passively received through the sense or by any form of communication.

2. Social interactions between and among learners are central to the building of knowledge by an individual.

3. Cognitive and the knowledge it produces are a higher form of adaptation in the biological context, in which the functional concepts of fit and viability.

4. Cognition's purpose is to serve the individual's organization of his or her experiential world; cognition's purpose is not the discovery of and objective of ontological reality.

In conclusion, although constructivism began as a theory of learning, it has progressively expanded its dominion, becoming a theory of teaching, a theory of education, a theory of both personal knowledge and scientific knowledge (Driver; & et.al. 1986: 5). Another expanded form of constructivism is a constructivist approach to curriculum development in science by Driver that I have adapted to develop the science program at Chiangmai zoo.

3.2 A constructivist approach to science program development

Adopting a constructivist view of learning also has implications for a view of science education programs. From the constructivist perspective, the learner constructs their own knowledge and the meaning that they have constructed is dependent on their prior knowledge as well as the learning situation provided. Driver and Oldham, *A Constructivist Approach to Science Program Development*, (cite) mentioned that the setting of the learning experience can enable the learners to develop their understanding. They suggested many important views that apply to science program development as follows, (Driver; & Oldham. 1986: 112):

1. The science program is seen as the program of activities from which knowledge or skills can possibly be acquired or constructed and acknowledging that what is constructed by any learner depends to some extent on what they bring to the situation.

2. The process of science program development should lie in the status that is determined prior to teaching through negotiation between adults to something with a problematic status.

3. The program development from a constructivist perspective has to incorporate an empirical reflexive approach.

The general model for the development of new curriculum materials being follow by the project that were provide by Driver and Oldham is given in FIGURE 3. This model indicates the actual curriculum design has drawn on many types of input. First, content, we can specify the experience which students should be exposed to and what ideas they may construct from these experiences. Second, what the curriculum developer should bring to the learning situation. Third, knowing the perspective on the learning process that involves conceptual change and active construction of meaning by learners will guide the curriculum developer to the selection of activities. Fourth, the practical knowledge of the students' school and classroom will guide teachers in how to organize learners to learn; how to present a problem to be of interest to a learner and how to deal with time, resources, and instruments. After developing curriculum materials and strategies for these inputs, the curriculum developer needs to implement the curriculum to explore what students can learn from the curriculum. Finally, the evaluation of such implementation is not only leads to the modifying in the materials but also the review, refinement or change in theoretical perspective and assumptions.

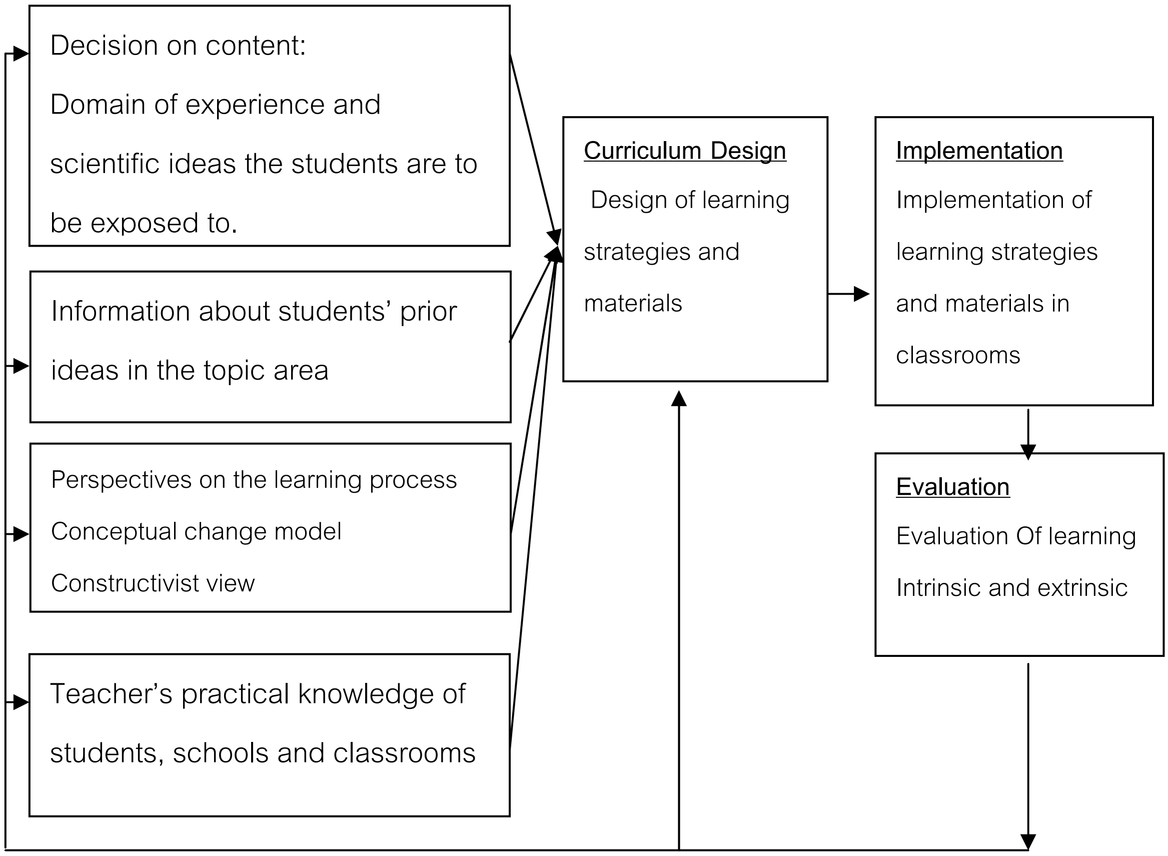

FIGURE 3 A CONSTRUCTIVIST MODEL FOR CURRICULUM DEVELOPMENT BY Driver and Oldham (1986)

3.3 The constructivist learning design (CLD)

The constructivist learning design (CLD) is developed by Gagnon and Collay. It is based on the assumptions and processes of constructivism theory and offers a different way of thinking about learning. The CLD emphasizes six distinct elements as follows (Gagnon; & Collay. 2000: 17-111)

3.3.1 Situation

A situation is a single task with a definite purpose that can define the entire learning episode. The situation elements focus on organizing learning episodes with specific purpose that stimulate students' power through the demands of a social situation.

A situation involves selecting a purpose for the learning episode and arranging a task for students to accomplish together that will fulfill this purpose. This task could be a problem to solve, a question to answer, a decision to make, a metaphor to create, a conclusion to draw, or a goal to set.

The teacher role is to present a challenging task for students to accomplish, support students in thinking together about doing the task, asking them to explain their thinking after completing the task, and guiding them in reflecting on their process of thinking and learning as they did the task.

3.3.2 Groupings

Groupings organizes students to accomplish the task framed in the situation and determines what materials they will use to explain their thinking. Grouping of students and materials are connected because the way students are grouped often depends on the situation that is arranged, the materials that are available, and the length of time that the groups will be together. Groups should be flexible and can range in size from dyads to a whole class depending on the purpose of the learning episode. Moreover, the groups should be small enough to allow students with divergent thinking styles to talk together effectively but large enough to represent different abilities and diverse perspectives. The basic principle for groupings is that students work together to construct shared meaning in the social construction of knowledge. A feeling of community develops between these students as they interact, think together to accomplish task, and present their thinking to peers.

3.3.3 Bridge

This element is critical to applying constructivist learning theory in a classroom. Before beginning any new learning, teachers can uncover the prior knowledge that the students bring with them; it serves as the foundation for a bridge between what students already know and the new learning theory they will engage in during a learning episode. To organize effective learning episodes, it is important to find out what current perception, construction, or misconceptions students bring with them. Teachers must understand what students actually know or think before introducing new learning. The bridge must link existing students' knowledge to new learning.

3.3.4 Questions

An open-ended and well-timed question will prompt learners to seek an answer and sets them off on a path to new knowledge. Usually, the best questions are those that learners ask themselves, those that prompt evaluative thinking. Moreover the questions that teachers ask and the way they ask them sustains or stifles learning for students.

3.3.5 Exhibits

We use the notion of an exhibit to describe student presentations of the artifacts they created to accomplish a task framed by the situation. As this process move from individual, private acts to more open and public exhibits, the power of social interaction shapes learning profoundly. Moreover, students will gain the basic social skills of critical thinking, communicating, and relating from an effective public presentation.

In this exhibit element, the groups of students will make a public presentations of the artifacts they have generate to document their accomplishment of a task during a learning episode. As students have an opportunity to show what they know to others, they take their accomplishment of tasks and the documentation of their learning more seriously. The product of their own thinking becomes a basis for their own thinking and becomes a basis for their presentations and provides an opportunity for peers to review their work. Students listen more attentively to one another and support one another in explaining their thinking when they present their work to peers. They also engage in more authentic work when they are preparing an explanation of their thinking for one another. This public presentation also provides a time and place for students to respond to questions from the teacher and from their peers about their artifacts or thinking.

3.3.6 Reflection

Reflection offers both learners and teachers the opportunity to think again about their individual and collective learning, to begin the integration of new learning with existing knowledge, to plan for the application of new knowledge and in many cases, to design strategies for the next learning episode. Reflections capture what student were actually thinking and learning, not what material was presented or covered.

Reflections have to parts. In the first part, the teacher engages the full group in interpreting and making sense of what has happened. Teacher review the learning episode with students to determine what concepts, process, and attitudes the student will take away with them. A primary purpose for this review is to give teachers a chance to perceive the student understandings that emerged during the learning episode. This process will assist teachers in evaluation of the purpose, flow and effectiveness of their learning design. Another purpose of teacher reflections is to allow teachers to revisit or restate concepts or understandings that were presented in a limited or inappropriate ways by the teacher or by student groups.

In the second part, students reflection on what they thought about while accomplishing the task and seeing the exhibit of presentations by other groups. Reflections include what students remember thinking, feeling, imagining, and processing through internal dialogue. Students might also reflect on what they learned today that they will not forget tomorrow or what they knew before, what they wanted to know, and what they actually learned.

Summary

According to the constructivists' perspectives above, learning is determined by the complex interplay among the learners existing knowledge, the social context, and the problem to be solved. Moreover, constructivism is a fundamental departure in both the nature of knowing, hence of teaching and learning. It is believed that knowledge and truth are constructed by people and do not exist outside the human mind (Duffy; & Jonassen. 1991: 9). The constructivists' perspective also describes learning as a change in a meaning constructed from experience (Newby; & et.al. 1996). Therefore constructivists suggest a set of instructional principles that can guide the practice of teaching and the design of the learning environments.

According to the study, *A Comparison between Traditional and constructivist Teaching in Environmental Science*, conducted by Lord found that student learning in an environmental science course can be considerably enhanced with constructivist-styled teaching (Lord,Thomas R., 1999. Moreover Classon and Lalik stated that the well-tested model of constructivism, science curriculum improvement study (SCIS), provides an excellent foundation on which to build constructivist-based lessons and these lessons encourages peer interaction in resolving instructor-generated problems as student to develop their understanding of science (Classon; &Lalik; 1993: 200). Because scientific knowledge is both symbolic in nature and also socially negotiated therefore the objects of science are not the phenomena of nature but constructs that are advanced by the scientific community to interpret nature (Driver; & et.al. 1994: 5). Thus in this study I focused on the way in which students' informal knowledge is drawed upon and interacts with the scientific way of knowing introduced in the informal science education based on constructivism and in the natural setting.

4. The thematic approach to science teaching and learning

A thematic approach to science is a combination of experiments, activities, children's literature, hands-on/minds-on projects, and materials used to expand a scientific concept or idea. Thematic teaching and learning is multidisciplinary and multidimensional, it has no boundaries and no limits. It is responsive to the interests, abilities, needs, and input of children and respects their developing aptitudes and attitudes. In essence, a thematic approach to science offers students a realistic arena within which they can learn and investigate scientific principles for extended periods of time (Fredericks; 1998: 16-17).

Thematic teaching in science is built on the idea that learning can be integrative and multifaceted. A thematic approach to science education provides children with a host of opportunities to become actively involved in the dynamics of their own learning. Therefore, they will be able to draw positive relationships between what happens in the classroom and what is happening outside of the classroom. Moreover thematic teaching promotes science education as a sustaining and relevant venture.

Thematic instruction in science offers many opportunities for students to be actively engaged in a constructivist approach to learning. It offers a variety of meaningful learning situations tailored to students' needs and interests. Children are given the chance to make important choices about what they learn as well as about how they learn it. Thematic instruction provides the means to integrate the science program with the rest of the school curriculum while involving students in a multiplicity of learning opportunities and ventures.

4.1 Advantages of thematic instruction

Thematic instruction in science offers a plethora of advantages for both teachers and students as follows:

1. Emphasizes and celebrates and individual's multiple intelligences in a supportive and creative learning environment.
2. Focuses on the processes of science rather than the products of science.
3. Reduces and/or eliminates the artificial barriers that often exist between

curricular areas and provides and integrative approach to learning.

4. Promotes a child-centered science curriculum, one in which students are encouraged to make their own decisions and assume a measure of responsibility for learning.

5. Stimulates self-directed discovery and investigation both in and out of the classroom.

6. Assist youngsters in developing relationships between scientific ideas and concepts, thus enhancing appreciation and comprehension.

6. More time is available for instructional purposes. Science instruction does not have to be crammed into limited, artificial time periods but can be extended across the curriculum and throughout the day.

7. The connections that can and do exist between science and other subjects, topics, and themes can be logically and naturally developed. Teachers can demonstrate relationships and assist students in comprehending those relationships.

8. Science can be promoted as a continuous activity not restricted by textbook designs, time barriers, or even the four walls of the classroom. Teachers can help students extend science learning into many aspects of their personal lives.

9. Teaches are free to help students look at a scientific problem, situation, or topic from a variety of view points, rather than the “right way” frequently demonstrated in a teacher’s manual or curriculum guide.

10. There is more emphasis on teaching students and less emphasis on telling students.

11. Teachers are provided with an abundance of opportunities of integration children’s literature into all aspects of the science curriculum and all aspects of scientific inquiry.

12. Teachers can promote problem solving, creative thinking, and critical thinking within all dimensions of a topic.

4.2 Building thematic units

Kucer (1993), cited by Fredericks (1998), has outlined a series of procedures that can assist teachers to develop the thematic units in science. His steps offer guidelines that can help instructors create and structure instructionally units effectively. In addition, this sequence of six stages provides the organizational framework for all of the thematic units. Procedures for thematic unit development are as follows (Fredericks. 1998: 21-23):

1. Identification of a thematic topic.
    a. The topic is relevant and of interest to the students.
    b. The topic is significant; it is important to know about.
2. Identification of major generalizations and/or principles upon which the thematic unit will be based.
    a. The generalizations and/or principles focus on big ideas rather than minor concepts, facts, or details.
    b. The generalizations and/or principle are interrelated.
3. Identification of key concepts that support the generalizations and/or principles.
    a. Each concept is related to several generalizations and/or principles.
    b. The concepts are critical to understanding the generalizations and/or principles.
4. Gathering of thematic materials.
    a. The materials focus on the same set of generalizations and/or principles.
    b. Materials include different types of source.
5. Brainstorming and generation of various activities related to the theme topic, generalization and/or principles, concepts, and materials.
    a. Activities are authentic in nature: linguistically, cognitively, developmentally, socioculturally.
    b. Activities engage students in the use of various communication systems to learn about the generalizations and/or principles and concepts in the theme.
    c. Activities engage students in the use of various thinking processes from different disciplines (science, social science, literature) to learn about the generalization and/or principles and concepts in the theme.
    d. Activities engage students in both collaborative and independent work.
    e. Activities provide students with opportunities for problem solving.
    f. Activities take advantage of differing intelligence.
    g. Activities help strengthen various intelligences.
6. Arrangement of thematic materials and activities.

a. There are opening activities that introduce students to the theme and closing activities that draw together and celebrate what has been learned and accomplished.

b. Materials and activities are arranged around particular generalizations and/or principles and related concepts

c. Materials and activities include the most simple/concrete to the most complex/abstract.

d. Materials and activities include the collaborative and the independent.

e. Throughout the thematic unit, activities require students to revisit priormeanings and to integrate them with current meaning.

5. Informal science education.

Science education reform documents always call for science to be thought in the manner that students learn best, by conducting hands-on, engaging, investigations using simple everyday materials. Often overlooked in the redesign of science education, informal science learning environments such as science centers, museums, and zoo can provide students with captivating science experiences that can be related closely to curricular objectives (Gassert. 1997: 433). Moreover, the minister of education in Thailand also suggested that all ministries are involved in providing informal education to promote lifelong learning. The services provided include educational activities or academic and professional programmers for different target groups relating to the responsibilities of each ministry.

Science teachers are in general willing to use field trips as a part of their pedagogy because they feel that their students need hands-on, real life experiences or to examine the applications of science which augments their classroom studies (Michie. 1998: 43-50).

Field trips that required hands-on activities seem to have a positive impact on student ability to recall information learned on the educational excursion, and students tend to enjoy this type of experience when compared to field trips that did not encompass hands-on activities (Pace; & Tesi. 30-40). Moreover, the study " Novelty and its relation to field trips, conducted by Hurd found that pre-visit agendas strongly influence students' positive attitudinal change and knowledge related to the trip (Hurd. 1997: 3).

Flak, Moussouri, and Coulson (1998), found that effective agendas for students' visit museum such as a pre-lesson on related material, or a specific list of exhibits to be viewed; correlated with an assignment to accomplish in museum or directly after field trip significantly influence on students' motivations of education and entertainment. They recommend that instead of taking a class to a museum and letting the students roam free, students should have a focus and they will appreciate the experience and gain more from it (Flak; Moussouri; & Coulson. 1998. 8). In addition, according to the study "Her world; for school children, field trips are a preview of life's yellow brick road", it is suggested that the purpose of the trip needs to be embedded in the curriculum. Therefore pre-visit and post-visit agendas should connect the material to the curriculum (Spano. 2002. 7).

5.1 Definition of informal science learning

Informal science learning is the most commonly applied term for the science learning that occurs outside the traditional, formal schooling realm (Dierking; & et al. 2002: 108). The National Science Teachers Association (NSTA) also recognized and encourages the development of sustained links between the informal institutions and schools. NSTA applied the term informal science education to programs and experience developed outside of the classroom by institutions and organizations that include (NSTA. online):

- Children's and natural history museums, science-technology centers, planetary, zoos and aquaria, botanical gardens and arboreta, parks, nature centers and environmental education centers, and scientific research laboratories
- Media, involving print, film, broadcast, and electronic forms
- Community-based organizations and projects, including youth organizations and community outreach services.

5.2 Characteristics of informal science learning environment.

Informal science education environments provide students with unique, engaging science learning opportunities and classroom teachers with a wealth of science teaching resources. Glassert (2003) suggested the characteristics of informal science learning environment as follows (Glassert. 2003: 435):

5.2.1. Motivational, engaging, enjoyable, and nonthreatening.

Informal learning environments have long recognized that learners are individuals arriving with differing interest, learning styles, and experiences in science.

Therefore Wellington (1990) concluded that the overall atmosphere of informal science learning areas, that are the most effective in developing learners interest and understanding of science, should include features such as voluntary, instructed, non-assessed, open-ended, and should be learning centered (Wellington. 1990: 247). Moreover, Semper (1990) added that informal learning environments provide a rich learning environment for learners with a variety of learning styles while implementing four themes in educational theory: curiosity or intrinsically motivated learning, multiple modes of learning, play and exploration during the learning process, and the existence of self-developed world views and models among people who learn science (Semper. 1990: 52).

5.2.2. Hands-on, experimental, and personal.

Informal science learning environments should provide free-choice, self-paced, multi-sensory and socially interactive spaces for learning-by-doing. Exploration and discovery are vital in fostering a child's natural curiosity, which lays the foundation for conceptual science learning (Bresler. 1991: 60). According to Sample, informal science learning environments allow students to observe and investigate natural objects and phenomena and live specimens in way that textbooks cannot (Semper. 1990). Moreover, Resnick (1897) indicated that when in-school programs draw on real-world relevance and are connected with outside-of-school learning it aids student in finding personal meaning in cognitive activity (Resnick. 1987: 15).

5.3 The influence of informal learning

Science museums, zoos and aquariums are places where informal learning can occur naturally and logically, creating an exemplary model for other types of museums. Bitgood (1994) stated that affective, and cognitive learning experiences are fused, not separately structured activities or objectives in informal exhibit environment (Bitgood. 1994: 63). Learning in informal settings depends less on verbal or written symbols for communication, thus permitting learners to interact with real-world objects without the additional learning of new or often confusing terminology. Informal science environments offer learners more direct nonverbal experiences, objects and visual displays, instead of discourse to relay information. Moreover, Gerber (2001) found that informal learning environments and classroom science teaching procedures showed significant effects on students' scientific reasoning abilities. Students with enriched informal learning environments had significantly higher scientific reasoning abilities compared to those with impoverished informal learning environments (Gerber, 2001: 535).

The studies focused on the effects of social interactions on learning in an informal science setting by Tuckey (1992) found that peer teaching was evident and students tended to recall the most information from exhibits that demanded their full attention and required active mental as well as physical involvement, whereas little was recalled of purely visual displays. Moreover NSTA strongly supports and advocates informal science education as below (NSTA, online):

1. Informal science education complements, supplements, deepens, and enhances classroom science studies. It increases the amount of time participants can be engaged in a project or topic. It can be the proving ground for curriculum materials.
2. The impact of informal experiences extends to the affective, cognitive, and social realms by presenting the opportunity for mentors, professionals, and citizens to share time, friendship, effort, creativity, and expertise with youngsters and adult learners.
3. Informal science education allows for different learning styles and multiple intelligences and offers supplementary alternatives to science study for non-traditional and second language learners. It offers unique opportunities through field trips, field studies, overnight experiences, and special programs.
4. Informal science learning experiences offer teachers a powerful means to enhance both professional and personal development in science content knowledge and accessibility to unique resources.
5. Informal science education institutions, through their exhibits and programs, provide an effective means for parents and other care providers to share moments of intellectual curiosity and time with their children.
6. Informal science institutions give teachers and students direct access to scientists and other career role models in the sciences, as well as to opportunities for authentic science study.
7. Informal science educators bring an emphasis on creativity and enrichment strategies to their teaching through the need to attract their noncompulsory audiences.
8. Local corporations, foundations, and institutions fund should support

informal science education in their communities.

9. Informal science education is often the only means for continuing science learning in the general public beyond the school years.

5.4 The influence of informal science education on environmental attitude

The use of outdoor areas for science instruction are advocated by science educators and curriculum theorist (Linda. 2000: 210; Aleixandre. 1996: 29; Stepath. 2004). The effectiveness of outdoor instructions was investigated focusing on varieties of environmental science content topics such as Zoology, Botany, Ecology and Geology. By reviewing these research studies, there is no doubt that students can learn about the environment from print, audiovisual materials, indoor lab activities and simulation activities but it is found that students can learn just as much or significantly more through outdoor environmental science instruction (Boger. 1998; Lisowski; & Disinger. 1991; Milton; et al. 1995; and Malone; & Tranter. 2003).

Several research studies also investigated the effect of outdoor environmental science instruction on environmental attitude in addition to the cognitive benefit associated with outdoor environmental science instruction. For example, from the study "*The Effectiveness of Schoolyards as Sites for Elementary Science Instruction*" conducted by Linda L. Cronin-Jones indicated that elementary students learn significantly more about selected environmental science topics through outdoor schoolyard experiences than through traditional indoor classroom experiences. Moreover these students also developed more positive environmental attitudes as a result of instruction (Linda; & Cronin. 2000: 203-211). In addition, many studies on the impact of long-term experiences in natural settings, such as summer camps or overnight filed trips, have documented positive shifts in students' environmental attitudes (Clinton L. Shepard; & Larry R. Speelman. 1986; Bogner. 1998; Dresner; & Gill. 1994; Kruse; & Card. 2004).

Summary

Informal learning in science will take place in a variety of contexts and through an increasing number of media. There is already evidence to suggest that factors outside of school have strong influence on students' educational outcomes (Schibeci. 1989: 13). According to the experts, informal science learning environments can engage and excite students to experience science in way uncommon to classrooms. I believe that informal settings have the potential to extended classroom science learning by providing students with a range of rich science process skills, scientific attitudes, a better attitude towards science, and improved attitudes towards the environment. Therefore learning outside of formal institutions, such as school, should are certain to be of growing importance in relation to the formal school curriculum and relevance to national science standards.

6. Education at zoo

A zoo is another learning resource capable of affording people opportunities to set their own learning agendas while exploring through contextually rich environments (Falk; & Dierking. 1998: 2). A zoo is the place that visitors have an experience with living animals, and provide the compelling experience necessary to attract and maintain personal connections with visitors of all motivations. Moreover it helps them to learn and reflect on their own relationships with nature (Povey; & Winsten. 2003: online). In addition zoos offer an opportunity for the children to experience wildlife – albeit in captivity.

Over the past few decades, many zoos have strengthened the educational focus of their mission. Traditionally the purpose was focused on influencing cognitive and affective variables by delivering animal facts and encouraging affection for the animals. However, in the past ten years there has been increasing sophistication within zoo education, with the focus on learning expanding from conveying facts about animals to influencing a broader public understanding about complex issues such as conservation and biodiversity. Similarly, the focus on affective impact has changed, as researchers have sought to understand the role of zoo experiences in the development of an environmental ethic. Even more recently, zoos have begun to address their role as facilitators of behavior change – seeking to influence their visitors' conservation-related behaviors (Groff; et al. 2005: 372)

Zoos can be ideal venues for developing emotional ties to wildlife and fostering an appreciation for the natural world as they offer a wide range of opportunities to engage in free-choice learning experiences through interactions with naturalistic exhibits. The heart of free-choice learning in zoos are certain perceptual strengths or preferred modes for processing information including auditory, kinesthetic, tactile and visual. It is through these that adults and children can effectively engage in learning in zoos. Beyond these, free-choice learning in the zoo is crucially dependent on individual motivation driven by unique intrinsic needs and by the interests of the child and by the duration of any interactive experiences, as well as the relevance, choice, discovery and context of the stimulating environment (Kola-Olusanya, Anthony. 2005: 300)

Zoos have also expanded their audience – from a traditional focus on school children to supporting the free-choice learning of the general public (Dierking & Saunders, 2004) and an increasing volume literature is focused on evaluating the long-term impact of visits to zoos (Holzer; & Scott. 1997; Adelman; *et al.* 2000; Dierking; *et al.*, Falk. 2002). A review of the research on zoos and an evaluation of the literature suggests that these experiences can positively influence guests' understanding regarding conservation (Adelman *et al.*,2000, 2001; Dierking *et al.*, 2002), as well as their attitudes and affect toward animals (Adelman, Falk; & James. 2000; Adelman; *et al.* 2001).

6.1 Conservation program

Much of the conservation education is being supported through zoological institutions around the globe. The resources that zoos are setting aside for this role are also increasing in an attempt to slow down the rate of extinction of our valuable species and habitats (WAZA. 2003. : Online). Efforts to preserve endangered species are vital in today's society and can be brought about through the conservation education mission of zoos. The role of modern zoos is represented in the unique niche of conservation education in teaching about biodiversity and conservation using hands-on techniques (Lindemann-Matthies. 2001: 194). The zoos' mission of today, according to Rosenthal (1991), is to promote an understanding of how basic ecological concepts relate to local natural resources. Through conservation education programs offered at zoos the public is encouraged to help preserve these natural resources (Rosenthal. 1991: 55).

Children are of the utmost importance in the future of natural resources preservation because their leisure pursuits are generally carried over into adulthood (Basile. 2000: 23). Conservation education is vital for encouraging youth to protect our resources now and in the future.If youth have a rewarding experience when visiting a zoo, then they may advocate for zoos and wildlife preservation in the future, that is, they may establish perceptions that may form the basis of their future attitudes (Marshdoyle; Bowman; & Mullins. 1982: 21).

Zoo conservation education programs include conservation education camps for youth. The idea behind these programs is to educate youth about the importance of wildlife, habitats, and behaviors so that they will be conservation advocates as youth and later as adults (Serrell. 1981: 41).

6.2 Education programs at zoo

6.2.1 Wildlife inquiry through zoo education (WIZE) program

A well-known life science program for grades seven through ten, wildlife inquiry through zoo education (WIZE) program, takes a non-traditional, multi-disciplinary approach to learning at Bronx zoo, New York, New York, USA. The program content focuses on population ecology, wildlife conservation, and species survival. Students who participate in the program scored significantly higher on a content-area posttest and had significantly more knowledge of and interest in particular science areas than did students not exposed to the curriculum. (Mei, Dolores M. 1996: Online)

6.2.2 Learning experience outside the classroom

Auckland zoo provides an educational programs specifically designed to meet individual classes' requirement. The purpose is to support a variety of curriculum areas and objectives for use before, during and after the zoo experience. For example, *Chameleons are cool*, the aim of this program was to spark children's creativity and interest in wildlife and the environment, and encourage students to reach for excellence (Auckland zoo. 2008: online).

6.2.3 Interactive distance learning with the Lee Richardson zoo.

The Lee Richardson zoo provides the public with free distance learning programs from their interactive television studio. Students of any age can connect for a one-on-one visit with the education staff and some of the special animal ambassadors. Students can choose one of the pre-planned program topics, or let the zoo educator create a program to fit the student's interests. Programs can be adapted to most grade levels (Lee Richardson zoo. 2008: online). Programs list are as follows:

1. Sophisticated mammals
2. Awesome amphibians
3. Protection from predators
4. Animal adaptations

5. Snakes, lizards, and alligators, Oh my!
6. The lions of the bird world
7. Animals of the prairie
8. Spineless animals
9. For the birds

6.2.4. BRONX zoo is just a phone call away!

The program uses two-way videoconferencing technology, where the Bronx zoo can bring engaging programs for K-12 students right into the classroom—live! All distance learning expeditions include several live animal "guests" gorillas, alligators, owls and more. Programs are 45 minutes to an hour and all include extensive teacher support materials. These time-tested, teacher-endorsed programs are aligned with the National Science Education Standards (USA) and have received rave reviews from students and teachers alike. (BRONX zoo. 2008: online)

6.2.5. Birmingham zoo

The education department at the Birmingham zoo offers science based classes as well. These classes combine science education with conservation education for home schooled students. The classes build upon student’s knowledge and enhance concepts by using the zoo as a living laboratory. Over the years, classes have consisted of animal visits, use of bio-facts, class discussions, in-class work, and homework.

Resources and references are made available for the different classes. Class materials are used in class and some sent home for extra reinforcement. The education department is dedicated to connecting students with nature and instilling an appreciation for the wildlife around them. Conservation education is an important aspect of the curriculum development at the Birmingham zoo (Birmingham zoo. 2008: online)

6.2.6 Taronga zoo

Situated on the foreshore of Sydney's magnificent harbour, the Taronga zoo showcases more than 350 different species of animals (Taronga zoo. 2008: Online). Education officers at the zoo can offer people of all ages a wildly different learning experience, allowing them to come face to face with the live animals. The zoo has already held a community education programs at Terry Hills, Live animals, audio recordings and photographs were used to educate visitors about the preservation of this precious local fauna.

The education program is the introductory level course for those who are interested in the animal care industry and/or pursing a career as a keeper in the animal care industry. The course is presented over a twelve-month period, with classroom sessions conducted once per fortnight at Taronga zoo. Students are also required to attend twelve practical industry days at Taronga zoo to perform the daily duties of an intern keeper under supervision. Students are also required to undertake course work in their own time.

Course assessments are a combination of written answers to questions, reports, projects, observations of students performing tasks, and supervisor reports. The program covers the essential duties of a keeper in the animal care industry. Included are the following topics:

1. Working in an animal care environment
2. Checking the general condition and health of animals
3. Animal handling techniques
4. Cleaning of animal housing/exhibits
5. Providing food and water for animals
6. Communicating effectively in the workplace
7. Basic first aid for animals
8. Food preparation for various animal species
9. Animal rescue and restraint processes
10. Presentations and tours

7. Chiangmai zoo

7.1 History

Chiangmai zoo was first founded by Mr. Harold M. Young, an American missionary who began collecting wild animals during his time teaching the Thai border police forest survival skills (Chiangmai zoo. 2006: Online) . He kept his menagerie in his large garden to be private zoo until it became too overcrowded. He then asked the Thai forestry department for land in order to open a zoo. In 1995 he was given 80 acres of land at the foot hill of the Suthep mountain and the animals were relocated. In 1974, Mr.Young passed away, the zoological park organization took over on 16 June 1977. The royal forestry department allowed the zoo to expand again in 1989 to 1327.5 acres. For over 20 years the site has been continuously developed and improved (Chiangmai zoo. 2006: Online).

Now Chiangmai zoo has 7,000 wild animals, the cages housing the animals have been made more occupant friendly, animals on view now include over 500 species and constant education programs for zoo personnel have made it the modern zoo it is today (20 Anniversary of Chiangmai zoo. 2006: Online).Today Chiangmai zoo is located on Suthep road near the Chiangmai University. Enclosed by flower gardens and surrounded by hilly terrain, it is home to thousands of species of wild plants and flowers adorning the natural landscape of valleys, streams and waterfalls. Chiangmai zoo is the first and only zoo in northern Thailand where visitors can experience the excitement and intimacy of various species of animals in their natural habitat

7.2 Fact sheet

Established	1977
Visitors	700,000/year
Size	212.4 acres
Animals	7,000 heads
Birds	4,965 heads
Mammals	475 heads
Reptiles	218 heads
Fish	1,190 heads
Open	08:00 - 21:00 hours
Entrance Fee	Foreigners - Adult: 100 Baht, Child: 50 Baht Thais - Adult: 50 Baht, College or University Student: 30 Baht, Child (over 135 cm.): 10 Baht

7.3 Chiangmai zoo map

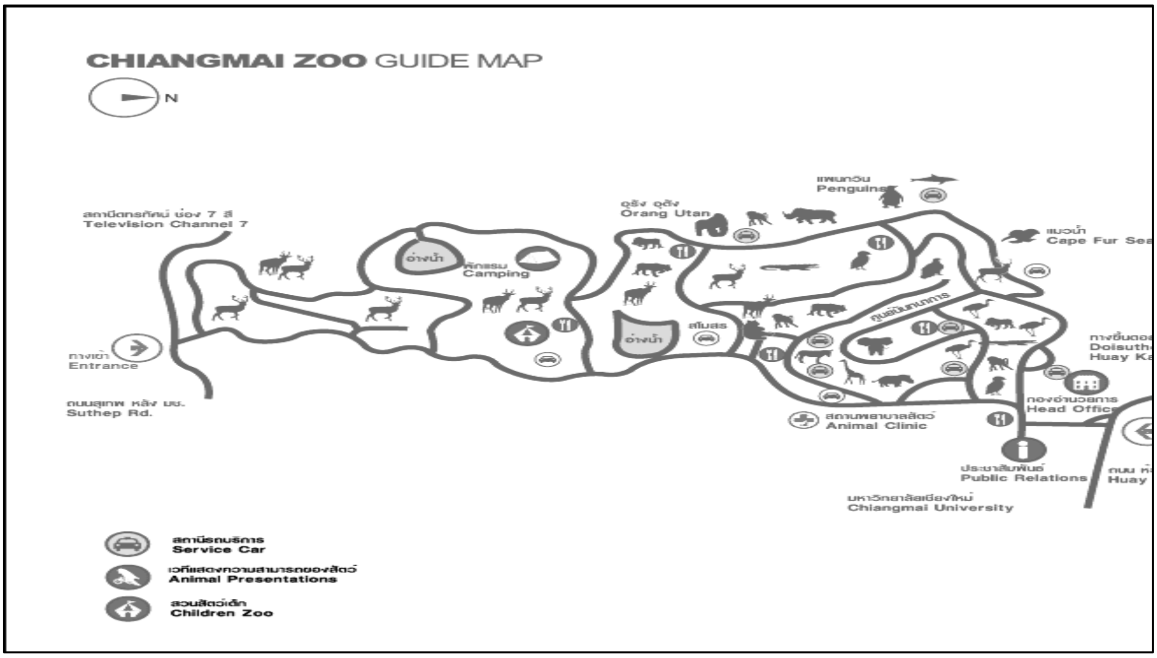

FIGURE 4 CHIANGMAI ZOO MAP (Chiangmai zoo. 2006: Online)

7.4. Attraction

7.4.1 Nakornping walk through aviary

Relaxation while walking and observing more than 800 birds in 2.5 Acres of land.

7.4.2 Fresh water aquarium

The collection of fresh water fishes includes more than 60 of tropical Freshwater fishes, featuring the giant Mekhong catfish and striped catfish, Siamese giant carp used for learning the life cycle of fishes.

7.4.3 Cape Fur seal exhibit

The building has 4 Cape Fur seal from Africa t present at the zoo.

7.4.4 Gibbon island

Animals live freely on this isle without nets, caging or any enclosure whatsoever. Gibbons live and breed happily at the zoo.

7.4.5 Camping area

The children can camp near the big reservoir, waterfall, adventurestation, the natural trail in order to learn about the animal's night life.

7.4.6 Star animals

Elephant family, hippopotamus, zebra, giraffe, ostrich, many birds species, cape fur seal, Humboldt penguin, Malayan tapir, barking deer and Indian rhinoceros make up the star attractions.

7.4.7 Open zoo

You will meet spotted deer, hog deer, barking deer, brow antler deer, alpaca, and peacocks which more than 200 animals that live with peacefully within an area of 40 acres. You can walk through the open zoo on the sky walkway for a close up view of the animals.

7.4.8 Twilight zoo

Chiangmai zoo is opened for every visitor to come to see many kinds of animals in the daytime. Naturally, most of animals would come out to eat and hunt at night. The animal life style at night is an interesting thing to study. Chiangmai zoo has the opened area which consists of the plenty of forests with a natural environment and at least 30 kinds of night animals. The concept of visiting night animal life is an idea that we would like to present as a new interesting and innovative zoo program to every visitor.

7.4.9 Giant panda live in Chiangmai zoo

In 2001, the vice-prime minister and minister of defense (a fullgeneral Chawalit Yongjaiyut) talked with the president and prime minister of the people's republic of china about the giant panda. He wanted to house a giant panda in Thailand. The government of China was glad to give a pair of giant pandas for friendship ambassadors and the celebration of her majesty the queen's 6 cycle birthday anniversary in 2004. The government of Thailand entrusted the zoological park organization to take responsibility for these very rare giant pandas. They are on display at Chiangmai zoo in Chiangmai province.

7.4.10 Koalas

In July 2006, Chiangmai zoo became the first zoo in Thailand to house koalas as Australia shipped four of the marsupials here to mark the 60^{th} anniversary of his majesty the king’s accession to the throne. Koalas, which are native to Australia, weigh about 9 kilograms each, on average. “Koala” is an aboriginal word, meaning “no drink”. The animals get water from their chief food, eucalyptus or gum leaves. The koala is sometimes called “koala bear” although it is not a member of the bear family but a marsupial like the kangaroo and the wombat. The trait distinguishing marsupials from other mammals is that they carry their young in pouches. Female koalas take 2 to 3 years to reach productive age while males take 3 to 4 years. A healthy female koala can bear one offspring yearly for about 12 years.

7.4.11 Children's zoo

The children's zoo, covering the area of 1,442 sq.m. consists of the cognitive development center, a small and large animal exhibit, playground, adventure sector, sand area, rabbit exhibit, a performing stage, exhibit hall, fish exhibit, and lotus pond. All of these are situated atop a natural hill overlooking the city of Chiangmai. The children's zoo is covered with shady evergreen trees, a beautifully landscaped floral garden, and masses of green grass.

7.5. Service

7.5.1 Public relations

Located on the left just beyond the main zoo entrance, the public relations office of Chiangmai zoo will help answer any questions zoo guests might have. Zoo guests are also be able to search zoo information on computers.

7.5.1 Souvenir shop

Located opposite admission gate, the shop sells animal postcards, T-shirts, buttons, memorabilia, film and more.

7.5.2 Film booth

Zoo guests can purchase film for cameras at film booths in areas near the admissions gate or rest areas.

7.5.3 Service car

For more comfort, safety, saving time you can get some knowledge from the zoo guides in a service car.

7.5.4 Animals presentation

Joyful, recreation, meet the lovely behavior of many wild animals.

7.5.5 Recreation and activity center

In special events, very useful for everyone, children's zoo has a natural education room for children and the whole family.

Summary

Every year more than 1 million people visit Chiangmai zoo (The zoological park organization. 2005: 21). Although Chiangmai zoo seeks to entertain, it has more important functions as well; it is an excellent source of education, a place to gain greater understanding of nature and the environment.

Chiangmai zoo is surrounded by hilly terrain which is home to thousands of species of wild plants and flowers adorning the nature landscape of valleys, streams and waterfalls. These environments are very suitable for science's teaching and learning. With the interdisciplinary and active learning possibilities of Chiangmai zoo, children from both private and government run schools can have a wonderful opportunity to learn first hand about the many fascinating aspects of basic science. Increasingly, Chiangmai zoo has received requests from teachers wanting a well organize educational program (The zoological park organization. 2005: 23). Toward this end, the constructivist thematic science program at Chiangmai zoo (CTSPZ) was developed based on constructivist learning design (CLD) and thematic science, in an informal setting, the Chiangmai zoo, to customize their offerings to the needs of particular teachers and students integrating the informal with formal school science standards.