CHAPTER 1

Introduction

Background

Academic knowledge and rapid technical advancement during the era of globalization has caused tremendous changes in the national, international, social and economic spheres. These changes necessitate the revision of the national education curriculum which is a fundamental mechanism for the development of national education quality. Thus in Thailand, the introduction of the so-called 'Education reform act' in year 1999, has changed the direction in Thai education. The ultimate goals are to foster morality, intellectual development, happiness, competitive potential and creative/ positive competition in the world arena (Ministry of education Thailand. 2002: 1).

Subsequently the National Education Act B.E. 2542 (1999) and amendments (Second National Education Act B.E. 2545 (2002)) defines education as a learning process that accelerates the prosperous growth of individuals and society. Moreover, the National Education Act stipulates the formulation of a basic curriculum to foster Thai-ness, good citizenship, and competency in the life skills, careers, and opportunities to further ones education. The basic education curriculum B.E. 2544 (A.D. 2001) is the national core curriculum that provides a framework for development of the school curriculum. It can be applied to formal, non-formal, and lifelong education systems, as well as education for special groups and talented children (Ministry of education Thailand. 2002: 1-3).

Science education in Thailand has also undergone changes so as to incorporate the modern philosophy of science education. It avails itself of an activity-based curriculum in which students play an active role in the learning process. Students need to learn how to search, to question, and to experiment (Sunee Klainin; & Pisarn Soydhurum. 2004: 3). Furthermore the goals of education have changed; memorization of facts is publicized as being less important than developing skills needed for problem solving and lifelong learning. Whereas theory and evidence are favoring a knowledge construction model over the information transmission model (Yarger; Thomas ; & Boysen. 2001: 19-23). Many reformers students are passive receptors of knowledge, towards a more student-centered understanding - based (constructivist) teaching that focuses on explorations and experimentation (Sermon; David; & Lee. 1999: 1).

Constructivist theories of learning emphasize an active and autonomous role for the learners to construct their own understanding through interacting in an environment in which the knowledge of the domain is not explicitly separated from the context in which it applies. The focus is on the process through which the learners experience the environment and interpret their experiences rather than on the acquisition of previously defined target domain knowledge. Learning thus needs to be student-centered and learners should be encouraged to make their own meaningful connections. As such, constructivism has become an intricate aspect of the current educational reforms and is included in national science education reform recommendations. Several educators have described various programs and studies in which teachers using constructivist teaching approaches have improved classroom discourse, increased achievement in science and altered misconceptions in science (Tobin. 1993: 53-62). In addition, it is suggested that thematic instruction in science offers many opportunities for students to actively engage in a constructivist approach to leaning (Fredericks. 1998: 17). Moreover, Hand (1997) found that students are not only appreciative of the opportunity to use their own ideas and knowledge but are also aware of the changing roles and responsibilities required of them within the constructivist classroom. It has been found that students preferred the constructivist teaching/learning approaches because they are allowed to think for themselves and they believed this is important when their own ideas are listened to and valued. They also felt that they had more input and involvement in lesson than was previously found in a tradition class (Hand; Treagust; & Vance. 1997: online). Therefore constructivism has become relatively well accepted in the science education community.

A commitment to constructivism is often inspired by the work of Dewey (1920), Piaget (1970) and Vygotsky (1962). These authors emphasize group learning as a factor in fostering knowledge construction because, for them, all learning takes place in a social context, and group learning per se is only one influence on the social construction of knowledge. Constructivism recognizes that; rather than knowledge being transfer from one individual to another, knowledge has to be constructed by each individual through his or her active engagement with the physical and/or social environment. Therefore, it is regarded in schools and other educational contexts as an appropriate milieu for learning in the vision of constructivism. Furthermore, Vygotsky (Vygotsky, 1978:130) regards schooling as the means of helping children develop scientific process and scientific knowledge. He purposed that science is not only the narrow stereotypical view of science as discipline but more generally to the notion of science as conventionally defined systems and processes of knowledge. Therefore scientific knowledge maybe constructed with practical knowledge that students develop through informal, everyday experience (Knuth; & Cunningham. 1993: 175-176). Constructivist theory suggests ways we can take advantage of the social nature of the classroom and provide meaningful experiences that may be more likely to transfer to the world outside the classroom for students.

Taking science outdoors is a natural step in this process. Children can gain a deeper understanding of science skills when they try an activity in a new setting. Through outdoor science activities, children build analytical as well as creative-thinking skills. They make predictions, test out hypotheses, and experiment with materials and ideas in variety of ways. With activities in informal settings, teachers will be helping children focus their natural curiosity and better understand the science process they are actually using (Early childhood today. 2003: 44). Moreover, it is found that science knowledge and attitude toward science develops as a result of children's expediencies both in and out of school. The importance of out-of-school experiences as a resource of scientific literacy has been widely acknowledged (Tamir. 1990: Online). Therefore learning that takes place in an informal setting may potentially address all three domains of learning, cognitive, effective and psychomotor (Beard. 1998. 1-4).

The classroom is no longer just a room with a four walls but the total environment has now become the classroom. Every area, whether near or far, holds numerous possibilities for observation, discovery and exploration. They are an inexhaustible resource for teaching science in any community (Gemake. 1980: Online). The environment, both formal and informal, exerts a powerful influence on learning. An informal learning environment refers to any setting outside the traditional classroom that provides an opportunity for interaction and exploration yet does not mandate learner participation (Crane. 1994: online). Consequently, the use of outdoor classrooms and informal education within the regular school curriculum has been supported academically by research and by educational philosophy (AAAS. 1989: online). Informal education can have a significant effect on academic achievement and it plays a vital role in the development of a child's mind and some may argue it could be more influential on their attitudes than formal education. Moreover, informal learning makes the students aware of their place in the environment thus helping them learn how to connect school learning to everyday situations. Thus, informal education can be utilized as a stimulating alternative instructional technique which can be used in conjunction with classroom learning (Messenger. 2000: 1-5). Furthermore informal education enables learners to learn by themselves according to their interests, potential, readiness, and the opportunities available from individuals, society, the environment, media or other sources of knowledge. It could be perceived that all ministries are involved in providing informal education to promote lifelong learning (Ministry of education royal Thai government. 2004: 30).

Learning that occurs in informal settings may enhance other learning when it is incorporated within instructional experience. Another benefit, gained form outdoor experiences, is that they provide a foundation for lifelong learning and leisure pursuits. More and more leisure activities take advantage of outdoor settings. Students who are learning in the outdoors are more apt to continue using the outdoor settings for active learning beyond their school years (The council for environmental education. 2004: online). According to section 25 of the national education act states that

> "the State will promote the running and establishment, in sufficient numbers and with efficient functioning, of all types of lifelong learning sources, namely: public libraries; museums; art galleries; zoological gardens; public parks; botanical gardens; science and technology parks; sport and recreation centers; data bases; and other sources of learning ".

Various efforts have been made to enable individuals to learn at all times and in all places from lifelong learning sources and the services provided including educational activities or academic and professional programs for different target groups relating to the responsibilities of each ministry. As these institutions expand, opportunities for children to learn also expand (Ministry of education royal Thai government. 2004: 84).

Informal learning has always been an integral part of environmental education. One specific location where environmental education has grown significantly is at accredited zoos. With the interdisciplinary and active learning possibilities of zoo education, it is only natural that there is a growing relationship between informal education and the environmental education resources available at accredited zoos.

Zoos are learning resources where education and learning are often expected outcomes. Many researches suggest that a zoo is a resource that can help students develop science knowledge, science skills, and a positive attitude (Carlin. 1999: 1-11). An important primary goal for many zoos is educating their visitors and increasing their visitor environmentally-friendly behaviors. White and Jacobson (1994) in their research *Evaluating Conversation Education Programs at a South American Zoo* found that knowledge and attitude about environment scores, of students whose teachers participated in the conservation education programs at a South American zoo, improved significantly (White; & Jacopson. 1994: online). In developed countries, research assessing the utility of environmental education programs has shown that students' active participation and the preparation and reinforcement of conservation information received during a field trip to a zoo, nature center, or museum influenced the cognitive and affective gains of school children (Koran; & et al., 1983: 325). Zoological parks, nature centers, natural history museums, and related institutions can play an important role in environmental education by improving understanding of human relationships with the natural world, fostering positive attitudes toward the environment, and promoting environmental action.

Over the years, little effort has been placed on meaningful integration of the resources found at informal settings into formal school curricular. However, little research has been conducted on using informal settings, especially zoos, for science education. Furthermore, few lesson plans or learning outcomes have been written for an excursion to any zoo in Thailand. Therefore, in this study the constructivist thematic science program at Chiangmai zoo (CTSPZ) was developed. The CTSPZ is based on constructivist learning design (CLD) and thematic science in an informal setting, the Chiangmai zoo, to customize the offering to the needs of particular teachers and students integrating informal with formal school science standards. The instructional materials were designed to support the national science standards appropriate for third level-secondary education grades 7-9 students. The

CTSPZ was designed as an instructional resource for educators who want to introduce students to hands-on/minds-on activities that encourage a constructivist approach and influence science process skills, attitudes toward science, scientific attitude, and attitudes toward the environment. The activities in the CTSPZ are intended for use in both classrooms and in informal settings. Moreover, the activities are easily to adapt in order to meet the learning requirements for academic disciplines including both science and environmental education.

Purposes of the study

The purposes of the study are summarized as follows:

1. To develop the CTSPZ for middle school students. The program development was based on a constructivism theory and thematic science.
2. To explore the use of the CTSPZ on students' science process skills, scientific attitude, attitudes toward science, and attitudes toward the environment by converging both quantitative (broad numeric trends) and qualitative (detailed views) data.
3. To evaluate the CTSPZ with emphasis on a constructivist learning environment

Research questions

The following primary research questions and associated hypothesis were formulated regarding middle school student's use of the CTSPZ at the Chiangmai zoo:

1. Does the use of the CTSPZ program designed by the investigator and offered at Chiangmai zoo, significantly influence student's science process skills?
2. Does the use of the CTSPZ program significantly influence students' scientific attitude?
3. Does the use of the CTSPZ program significantly influence students' attitude toward science?
4. Does the use of the CTSPZ program significantly influence students' attitude toward the environment?

5. Does the incorporation of the CTSPZ provide a constructivist learning environment?

Research Hypothesis

1. The designed CTSPZ program significantly influences student's ability to use science process skills.
2. The use of the designed CTSPZ program significantly influence students' scientific attitude.
3. The designed CTSPZ program significantly influence students' attitude toward science.
4. The designed CTSPZ program significantly influence students' attitude toward the environment.
5. The incorporation of the CTSPZ provides a constructivist learning environment.

Significance of the study

Scientific questions and environmental issues have been increasingly brought to the forefront of everyday life in Thailand however these issues are usually not included in the formal education. Therefore, the combination of formal school experiences, informal experiences (zoos, science and other museums, planetariums, etc.), and non-formal science experiences (scouts, science clubs, etc.) for youth is critical for improving their attitude towards science and attitudes toward environment (Carlson; & Maxa. 1997: Online).

Informal science education is still in its infancy in Thailand. Many educational issues simply have not been investigated, especially in the area of outdoor education. In other parts of the world, more studies had been conducted concerning informal science education. Tamir (1991) mentioned that informal science activities (discussions, watching TV, listening to the radio, reading and other activities, such as visits to museums and field trips) were found to be associated with a strong commitment to science and science learning. Moreover, the research "*Zoo as a source of free choice*" reported that the learning of science at zoos is not limited to general visitors and the learning of science for school children can be enhanced by pre- and post-visit activities and strong curricula links (Tofield; & et,al. 2003: 67-99).

The investigator who completed the research review found that there were a few studies that integrated informal education with formal education. The literature revealed a few studies that combined science process skills, scientific attitude, attitudes toward science, and attitude toward the environment. In Thailand specifically, there were a few studies that have integrated informal science with national science standards to be used in formal science classrooms. Although there is evidence that learning science in informal settings can influence science process skill, scientific attitude, attitude towards science, and attitude towards environment, no specific research has addressed a quantified assessment of their relationships.

The outcomes of this study provided information about relationship between students' science process skills, scientific attitude, attitudes towards science, and attitude towards the environment. These outcomes may be used by science educators to consider the relationships between informal science and formal science education. Educators will also be able to use the CTSPZ program to guide their thinking to developing teaching strategies for their students according to students' science process skills, scientific attitude, attitudes towards science, and attitudes towards the environment. Furthermore, this study provided a foundation of an introductory courses in science by integrating informal science education with formal science education.

Delimitations

Population of the study

The populations of this study were middle school students who enrolled in the CTSPZ.

Sample of the study

The sample of the study is limited to 120 students in level three's student population at 2 secondary schools located at the Chiangmai province as follows.

1. Chiangmai University demonstration school (Satit CMU)

   Experimental group 30 students

Control group from 30 students

2. Navamindarajudis Phayap school (NMP)

Experimental group 30 students

Control group from 30 students

Variables of the study

Independent variable

The constructivist thematic science program at Chiangmai zoo

Dependent variables

1. Science process skill
2. Scientific attitude
3. Attitude toward science
4. Attitude toward the environment
5. Constructivist learning environment

Conceptual framework of the study

The conceptual framework for this study evolved as a consequence of the literature review in the field of constructivism, thematic science, curriculum design and informal education. In FIGURE 1, the development of the constructivist thematic science program at Chiangmai zoo is based on constructivism and thematic science theory.

The constructivist approach has been evident in education research in a variety of ways; constructivist theory suggests way we can take advantage of the social nature of the classroom and provide meaningful (Smerdon; Burkam; & Lee. 1999. 5); constructivist teaching approaches have improved classroom discourse, increased achievement in science and science process skills (Tobin ,1993: 53-62); constructivist teachers build science curriculum on processes, themes and content that influence scientific attitude as well as scientific knowledge (Waite-Stupiansky. 1997: 141); constructivist research promises to illuminate attitude toward the environment (Roberston. 1994: 31). Consequently, thematic instruction in science offers many opportunities for students to actively engage in a constructivist approach to learn (Fredericks. 1998: 17).

FIGURE 1 is an attempt to describe the theoretical framework of the study and to identify the relationship between the CTSPZ at informal setting (Chiangmai Zoo) and science process skill, scientific attitude, attitude toward science, attitude toward the environment, as well as constructivist learning environment.

Independent Variables		Dependent Variables
The constructivist thematic science program at Chiangmai zoo 1. Instructional design is based on the constructivist learning design (CLD) 2. Science content is aligned with the national science standard for level 3 students. 3. The setting is an informal setting at Chiangmai zoo.	→	1. Science process skills 2. Scientific attitude 3. Attitude toward science 4. Attitude toward the environment 5. Constructivist learning environment

FIGURE 1 CONCEPTUAL FRAMEWORK OF THE STUDY

Framework of the Study

The framework for this study is evolved as a consequence of the literature review in the field of curriculum design, thematic science, and informal education. In FIGURE 2, the development of The CTSPZ is based on constructivist learning design, science standards, and informal education. It is hypothesized that students who attend in science programs are representing the increasing of science process skills, scientific attitudes, attitudes toward science, attitudes toward the environment, and constructivist learning environment.

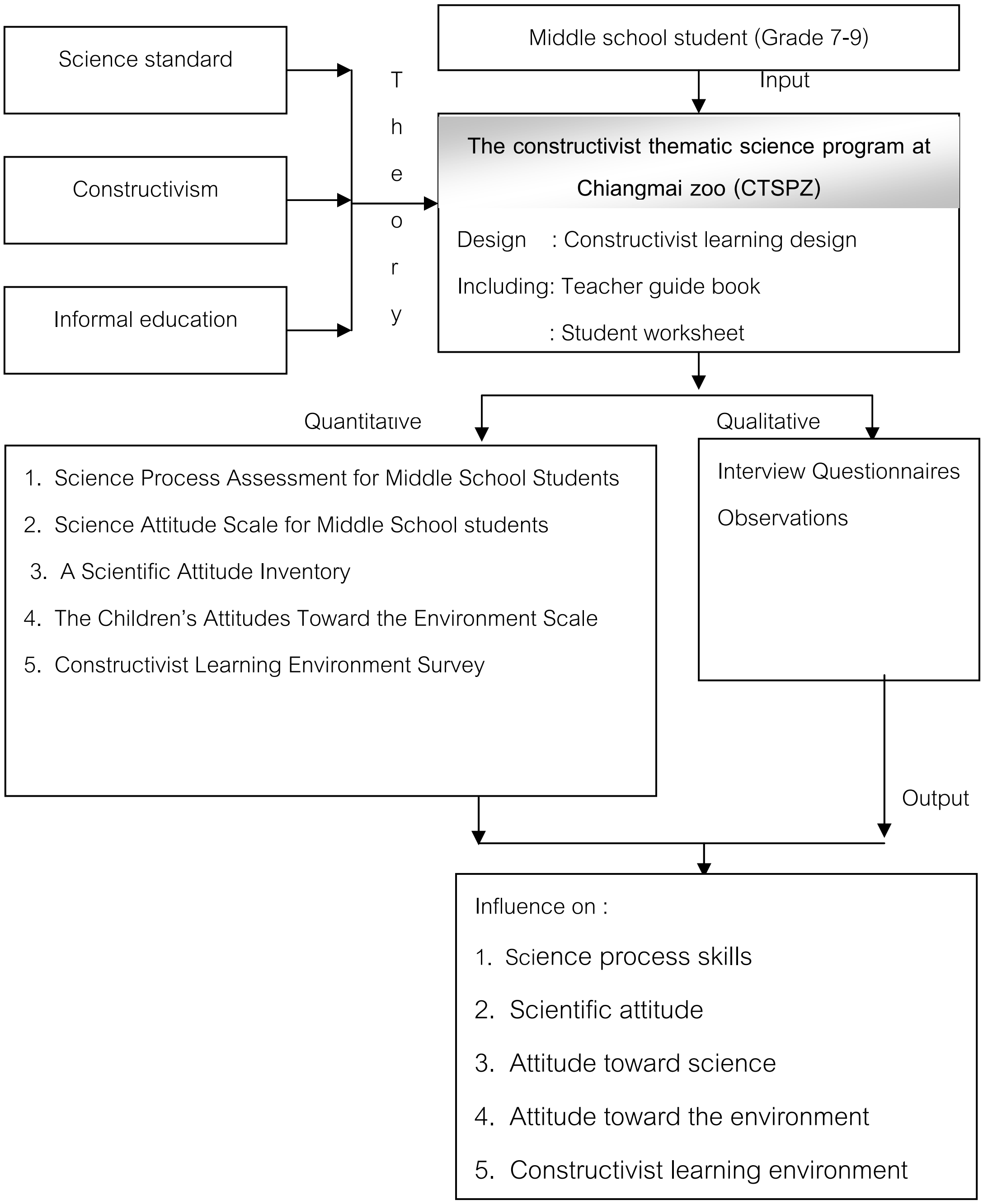

FIGURE 2 FRAMEWORK OF THE STUDY

Definition of the study

1. **The constructivist thematic science program at Chiangmai zoo (CTSPZ)** is a teaching-learning program that was developed based on constructivism and thematic science theory. It provides background information and activities for teaching basic science that incorporated the Thailand national science standards at the Chiangmai zoo. The CTSPZ

was created to provide students with hands-on/minds-on activities that are crucial to taking theoretical learning into the real world. The activities in the CTSPZ are ready-made for student grades 7-9. Informational materials include teacher guide book and student's worksheet that include pre-and post- visit activities, on-ground activities, and data sheets to be used at the Chiangmai zoo.

2. **The constructivist learning design** was developed by Gagnon and Collay (2001). When using this model, teachers implement a number of steps in their teaching structure. The model consists of six basic steps that flow back and forth into one another as the lessons proceed (Gagnon; & Collay. 2001: 2).

2.1 **The situation** frames the agenda for student engagement by delineating the goals, tasks and forms.

2.2 **Groupings** are the social structures and group interactions that will bring students together in their involvement with the tasks and forms of the learning episode.

2.3 **Bridge** refers to the surfacing of students' prior knowledge before introducing them to the new subject matter. The bridge is at the heart of the constructivist methodology; students are better able to focus their energies on new content when they can place it within their own cognitive map, values, attitudes, expectations, and motor skills.

2.4 **Questions** aim to instigate, inspire, and integrate students thinking and sharing of information. Questions are prompts or responses that stimulate, the student to extend or synthesize their thinking and to communication throughout the learning episode.

2.5 **Exhibition**, in this phase the teacher asks students to publicly present what they have learned. This social setting provides a time and place for students to respond to queries raised by the teacher, by peers, or by visitors.

2.6 **Reflections** offer students and teachers opportunities to think and speak critically about their personal and collective learning. This encourages all participants to synthesize their learning, to apply learning artifacts to other parts of the curriculum, and to look ahead to future learning episodes.

3. **Constructivist learning environment** refers to the place where learners may work together and support each other as they use a variety of tools and informational resources in their guided pursuit of learning goals and problem-solving activities.

4. **Thematic science** refers to a combination of experiments, activities, hands-on/minds-on projects, and materials use to expand a scientific concept or idea in all 8 principal sub-strands of the National Science Curriculum Standard. It is built on the idea that learning can be integrative and multifaceted.

5. **Formal education** is the traditional way of education that most Thais' visualize school. It takes place within a classroom consisting usually of one teacher and several students. Formal education shall specify the aims, methods, curricula, duration, assessment, and evaluation conditions to its completion.

6. **Informal education** is education that takes place outside the classroom in an environment absent from some of the classroom's limitations. It encourages learners to assume responsibility for their learning and to monitor their learning as it occurs.

7. **Science process skills** refer to the process of doing science. Science process skills are classified as basic skills and integrated skills. These skills can be assessed by applying them to a series of learning episodes.

8. **Scientific attitude** refers to a way in which scientist believe in and conduct their work. Scientific attitude includes the characteristics of scientists that are believed to be desirable in the study of science, such as open-mindedness and objectiveness.

9. **Attitude 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.

10. **Attitude toward the environment** refers to the learner's predisposition to respond consistently in favorable or an unfavorable manner with respect to the environment and the reorganization of the importance of ecologically sustainable development and the conservation value of nature environment.