DEVELOPMENT OF A CURRICULUM FOR ENVIRONMENTAL EDUCATION ON MANGROVE FORESTS FOR LOWER SECONDARY SCHOOL STUDENTS IN SAMUTPRAKARN PROVINCE

PRAROP KAOSES

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The objective of this research was to develop an environmental education curriculum on mangrove forests for lower secondary school students in Samutprakarn province. There were preliminary steps to be carried out for this study, beginning with a documentary review of basic data, project site survey and government agency policy study. The basic data were analyzed and used for designing the curriculum. This design was again reviewed by experts, technical educators and school teachers. Subsequently, the review of the curriculum was implemented by two experimental groups. One group included students in the project area, while the other group consisted of students outside the study area. There were a total of 60 students with 30 students in each group. The samples were done by stratified sampling.

The results from the implementation of the development of the curriculum were found to be effective according to criteria regulations. It was indicated that after the course had been completed, the knowledge, attitude and practice of the students in both groups were increased as compared to prior to the training with a statistical significance at .01 level. The post-test average score of the students was higher than the pre-test average by 60 percent. Both the trainers and students expressed a high level of satisfaction concerning the curriculum.

From the result of this investigation it can be concluded that the development of this curriculum is appropriate for both lower secondary students inside and outside the study area.

3937546 SHED/D : สาขาวิชา ; สิ่งแวดล้อมศึกษา ; ศษ.ด. (สิ่งแวดล้อมศึกษา)

ปรารภ แก้วเศษ : การพัฒนาหลักสูตรสิ่งแวดล้อมศึกษาป่าชายเลน สำหรับนักเรียนระดับมัธยมศึกษาตอนต้น จังหวัดสมุทรปราการ (DEVELOPMENT OF A CURRICULUM FOR ENVIRONMENTAL EDUCATION ON MANGROVE FORESTS FOR LOWER SECONDARY SCHOOL STUDENTS IN SAMUTPRAKARN PROVINCE) คณะกรรมการควบคุมวิทยานิพนธ์ : มาณี ไชยธีรานุวัฒศิริ, ค.ด. วินัย วีระวัฒนานนท์, Ph.D. สนิท อักษรแก้ว, Ph.D. 185 หน้า ISBN 974 – 665 – 339 – 3

วัตถุประสงค์ของการวิจัย เพื่อพัฒนาหลักสูตรฝึกอบรมสิ่งแวดล้อมศึกษาป่าชายเลน สำหรับนักเรียนระดับมัธยมศึกษาตอนต้น จังหวัดสมุทรปราการ ซึ่งประกอบด้วยขั้นตอนการดำเนินการ 5 ขั้นตอน โดยเริ่มจากการศึกษาข้อมูลเบื้องต้นจากเอกสารงานวิจัย การสำรวจพื้นที่ศึกษาวิจัยชุมชน และนโยบายของหน่วยงาน แล้วนำผลการวิเคราะห์ข้อมูลมาออกแบบสร้างหลักสูตร หลังจากนั้นให้ผู้ทรงคุณวุฒิ นักวิชาการและครูผู้สอนได้ตรวจสอบเอกสารหลักสูตรที่สร้างขึ้น นำไปปรับปรุงแล้วนำมาทดลองใช้กับนักเรียนระดับมัธยมศึกษาตอนต้น จังหวัดสมุทรปราการ จำนวน 2 กลุ่ม คือ กลุ่มนักเรียนที่อยู่ในพื้นที่ศึกษาวิจัยและกลุ่มนักเรียนที่อยู่นอกพื้นที่ศึกษาวิจัย กลุ่มละ 30 คน รวม 60 คน โดยสุ่มตัวอย่างแบบชั้นภูมิ

ผลการทดลองใช้หลักสูตรพบว่า หลักสูตรที่พัฒนาขึ้นมีคุณภาพตามเกณฑ์ที่กำหนดไว้ คือ หลังจากการฝึกอบรม ความรู้เจตคติ และทักษะการปฏิบัติของผู้เข้ารับการฝึกอบรม มีระดับสูงกว่าก่อนการฝึกอบรมอย่างมีนัยสำคัญทางสถิติที่ระดับ .01 คะแนนเฉลี่ยของความรู้ เจตคติ และทักษะการปฏิบัติจากการทดสอบหลังจากฝึกอบรมสูงกว่า 60% ทั้งวิทยากรและผู้เข้ารับการฝึกอบรมมีความเห็นว่าหลักสูตรฝึกอบรมมีความเหมาะสมอยู่ในระดับมาก จากผลการวิจัยครั้งนี้ สามารถสรุปได้ว่า หลักสูตรฝึกอบรมสิ่งแวดล้อมป่าชายเลนที่พัฒนาขึ้นมีความเหมาะสมที่จะนำไปใช้ในการฝึกอบรมนักเรียนระดับมัธยมศึกษาตอนต้น ทั้งในพื้นที่ศึกษาวิจัยและนอกพื้นที่ศึกษาวิจัยได้

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CHAPTER I
INTRODUCTION

1. Background of Study

In the past two decades of national development, natural resources have been utilized to increase national products and to increase population incomes as well as to raise the living standard of the Thai people. This has been done in the absence of adequate and appropriate management in order to enrich the growth of the economy in a short period of time. The unplanned nature of national resources management caused the degradation of resources and the environment. This, in turn, caused insecurity concerning economic development, and provoked strong conflicts among people in the country due to the competition for natural resources. Furthermore, natural hazards, such as floods, hot climate and long droughts, occurred year after year. Meanwhile the economic growth and city- community expansion increased pollution, waste products, and effluent, which is dangerous to human health. (Office of National Economic and Environmental Development, 1996 : 131) If the development and restoration of natural resources and the environment continue to be neglected by the government, private sectors and the public, it may become too late to implement environmental conservation.

Development of economic and social policy in the coming years, therefore, must stress the efficient use of natural resources, including wise management of agricultural products and regulations to prevent industries from destroying the quality of the environment. The International Trade Treaty must be upheld. The environmental quality control in the years to come must include the following concepts: (Office of Environment Policy and Planning, 1997 : 9-10)

1. Natural resources are the basis of sustainable economic development. The use of natural resources should be based on conservation and social justice.

2. Effective administration and environmental quality management systems should be viewed as a whole by authorities. Distribution should proceed from

centralization to localization in order to open up partnerships among government sectors, private sectors, and the public from the policy making phase through the evaluation phase.

3. The public should participate in environmental problem- solving and restoration of environmental quality.

Agenda 21 of the Earth Summit at Rio-de Janeiro, Brazil states that population, consumption, and technology are the main factors which have changed the environment. It is necessary to seek means of decreasing the overwhelming consumption in some parts of the world while supporting sustainable development in other areas. The Summit recommended policy and plans to reach a sustainable balance between consumption, population, and the Earth's life supporting capacity to serve human consumption demand. In addition to managing comsumption, governments should exercise care in the management of natural resources. (Ministry of Foreign Affair, 1994 : 10) In chapter 8, the Summmit agreed to encourage the government of each country to set up sustainable development strategy with an emphasis on education and training of the people in order to increase awareness of environmental problems. (Michael Keating, 1993 : 14-57). Each country must realize that environmental education is an obvious necessity of human development and sustainable environmental development. (UNEP, 1994 : 1)

Mangrove forests are an important natural resource along the sea coast, the mouth of the rivers and around islands. Mangrove forests in Thailand cover the Gulf of Thailand from Cholburi, Rayong, Chantaburi and Trad provinces, altogether around 79,122.5 Rai or 7.9% of the total land-mass of Thailand. At the innermost point of the Gulf at Samutprakarn, Samutsakorn, Samutsongkram, Phetcburi and Prajoubkeerikan provinces mangrove forests cover around 34,056.75 Rai or 3.5% of the land. In the southern region of Thailand, mangrove forests cover around 933,211 Rai or 8.6%, the largest concentration of mangrove forests in the country. They seatter along the west coast at Ranong, Pangnga, Puket, Krabi, Trang, Satool, Chumporn, Surattani, Nakornsrithamraj, Songkla, and Pattani provinces (Sanit Aksornkoae, Sonjai Havanon, Chatree Maknual 1992 : 1-5)

Mangrove forests have long been associated with the lives of Thai people. Mangroves produce the best charcoal of its kinds, which can make hundreds of

million of Bath each year as an export good. Its wood can be used to build houses and furniture. Mangrove forests are very important to marine fishery; they provide shelter and food sources for small fish and new- born marine creatures. The foodchain and foodweb of the mangrove forests are valuable ecosystems and relate to the life of fishermen and their revenue. (Sanit Aksornkoae, 1989 : 12-19)

The importance of mangrove forests has been recognized by the government, which has implemented resolutions to protect and conserve the forests. The cabinet proclaimed in 1978 that all activities concerning the mangrove forests must be approved by the National Committee on Environment. (Department of Environmental Quality Promotion, 1995 : 17) But in the past two decades, the degradation and deforestation of mangrove forest by crayfish farming has increased, as can be seen in the following table.

Table 1 Decrease in Mangrove Forest Area

Time	Rate of decreasing (area in Rai)
1961 – 1975	345,000
1975 – 1979	158,000
1979 – 1986	567,950
1986 – 1991	142,625
1991 – 1993	30,784
1993 – 1996	6,876
1961 – 1996 (36 years)	1,251,985

Sources : Thongchai Jaruppat and Jirawan Jaruppat, 1997.

Finally the government canceled the concession of all mangrove forests beginning on November 19, 1996 and issued urgent measures to protect and restore the mangrove forests. These measures include:

1. The protection of mangrove forests plan.
2. The conservation of natural resources and environment of mangrove forest plan.
3. The restoration of mangrove forests plan.

4. The transformation of technology and evaluation plan. (Somchai Sreemongkoltip, 1997 : 4)

However, the deforestation of mangrove areas is still an unsolved problem. Many invaded areas have become degraded areas with no value. One possible solution to the problem is to stimulate awareness and acknowledge the value of mangrove forests by encouraging and educating our young generation and the public to participate in conservation activities and to restore the forest in their communities. Such an activity coincides with the promotion and support from the Office of Policy and Environmental Planning (1997 : 85) which aims at modelling the development of environmental education and appropriate implementation.

The young generation, groups of students in schools, are the most powerful, original, critical, and creative thinkers. They are the power bond and linkage between schools, homes, society and community. These advantages should be pooled to campaign for the conservation and restoration of mangrove forests and environment. (Vinai Veeravatnanond and Others, 1998 : 88 ; Kasem Chunkao, 1993 : 159). They are supporters to protect the forests by discouraging invaders from cutting down the forest in their communities. (Eag-Vit Na Talang, 1998 : 2).

The behavioral adjustment of the students at these ages should be given priority within homes, schools, and community because this will impact the environmental problem in many ways. (Prathampidok, 1996 : 238-239) Teen-age youngsters display changing attitudes and behaviors; they may to accept, reject, or oppose things easily. Between the ages of 11-15 years, youngsters are in the formal operation stage. (Piaget, 1972 : 5) They are able to think logically, are interested in social events and actions, begin to build up attitudes towards people and society, and display a high level of eagerness and talent. Bruner (1996) also stated that teen-ages can build up concepts about many things and change back and forth rapidly. Therefore, students at this age should be carefully and creatively taught and trained for the future of the country. (Pornpimol Jeamnakarin, 1996 : 171) A UNESCO (1994) project to prepare youth for the 21st century in environmental education programs recommended that teachers are the resource personnel whom the students trust. Thus the principal duties of the teachers are to lead, guide, and train them in the

right way of living with a sense of responsibility to society in the future. (Kastemholz, Hans G. and Erdmann, Karl H. 1984 : 15-17)

The Earth Summit meeting at Rio-de Janeiro, Brazil in June 1992 recommended Agenda 21 as the master plan of the world for sustainable development. This Agenda stresses the continual education of youth regarding their role to protect the environment and partnership in decision making towards environment and development. (Ministry of Foreign Affairs, 1994 : 59) Education and training in the local environment of each region will stimulate and encourage awareness and appreciation of the value of the environment. At the International Children's Conference held in Eastbourne, United Kingdom on 23-25 October 1995, more than 800 children from 83 countries requested the government of each country to be in friendship with the environment and take action to protect the environment as soon as possible. (ASEP Newsletter, 1996 : 6, 13) This shows that the new generation are interested in and anxious about the environment. However, sustainable problem solving on environmental issues should be based on correct information and stable data-bases. Environmental programs should also encourage students to develop awareness and acknowledge the value of the environment (Arjampol Kumpanond, 1998 : 39), which will lead to partnership for real environmental problem- solving.

In Thailand, youngsters have been encouraged and promoted to take a role in conservation of natural resources and environment in the same manner as government and private sectors and NGOs. The youth assembly under the leadership of Rung Arun Project (The Dawn Project) and Environmental Institute gathered youth from all parts of the country to deal with conservation of the environment and energy and social problems. Such programs stimulate the youth to realize their role and responsibility toward the environment. They have a chance to exhibit their products (out put of their projects) to the public. (Thai Environmental Institute 1997 : 19) The Ministry of Education has been charged with implementing environmental education for youth in Thailand through integrating the corresponding issues into school curriculum. (Ministry of Education 1991 : introduction)

The Department of General Education has realized its role and duties to respond to solve the national problems regarding the environment through means of education; secondary school students should be taught and trained to love their land

and environment and be responsible to solve and protect their environment. (Banjong Pongsart : 1994 : 1) Every school should integrate environmental education (EE) and activities to their teaching – learning strategy. In 1995 the Department of Secondary Education requested all schools to revive, conserve, and develop the environment in schools and communities near sources of drinking water and water supplies. Schools that are situated in wet lands, mangrove forests, swamp forests, water channels, ponds, or sea coast areas should stress the balance of nature and utilize those areas as sources of learning and field practices for the students and public as well as conserve the biodiversity and implement medicinal plant garden projects. One study found that many secondary and elementary schools, such as Haad-amra-aksornlakvitaya school in Samutprakarn province, have integrated conservation into the environmental science curriculum by including mangrove conservation activity with an outdoor or field study component in the lesson plans. The result of this activity is that students acknowledge the value of mangrove forests and learn how to participate in mangrove planting. (Sudjai Teppitaksak, La-or Chewaprapi and Pirut Kunsit, 1997 : VI-2). At the level of primary school, Ban Lam School, Pechaburi Province has integrated a mangrove forest program into the environmental science subject. The result of the learning activity is that students have knowledge, a good attitude and feel more motivated to participate in mangrove conservation (Piyaporn Sripalawong and Narin Jetanasumritchok, 1997 : VI-1)

The integration of environmental education at the secondary school level of curriculum development through offering environmental education as an elective course followed an evaluation on achievement tests. The tests scores on science courses averaged 49.12% while social science averaged 57.43%, which indicates that the secondary school students have an inadequate knowledge and understanding of the context of environmental education (Department of Curriculum and Instruction Development, 1993 : 21-22). Analysis of the teaching-learning processes found that some schools applied the curriculum in a manner which did not coincide with the objectives and purposes of the curriculum. (The Environmental Institute, 1998 : 20) It is also reported that ninth grade students in the Bangkok metropolitan area have a negative attitude towards partnership on environmental problem solving. (Kesara

Pitayapanu, 1995 : Abstract). All of these research results indicate that environmental education still has not reached its goals and objectives.

Education is an important process in human development because it promotes morality and harmonious interaction with the environment. Men are part of nature and the environment and have lived with the environment harmoniously for millions of years. Therefore, men should realize the value of nature and avoid destroying the environment. (Surat Silapa-anond, 1998 : 43) All people and organizations should be comprehensively involved in environmental education (UNESCO, 1993 : 13). Society and the environment experience rapid, continual changes continually and school curriculum should therefore be adjusted and improved accordingly in a manner appropriate to the age and development period of children. Teaching – learning and training should stress practical skills and experiences rather than rote memory learning. (Pornpimol Jeamnakarin, 1996 : 27) EE is education for life and it is a continual process. (UNESCO, 1978 : 27) In order to encourage realization, awareness and responsibility to protect and restore the environment, EE should be based on real learning and relate closely to nature and the environment through continual practice and direct experience. (Lozzi, L. 1990 : 41) Current EE programs have not been successful in encouraging youngsters to develop a positive attitude and sense of realization and responsibility towards the environment. (Environmental Development Circle, NA date : 48.5) This may be due to the fact that teaching-learning activities in secondary schools have not included community participation and partnership. (UNESCO-UNEP, 1991 : 1-2) Students as well as teachers have paid little attention to community and environmental problems. (Wals, 1992 : 45) The main problems are the lack of EE qualified teachers and the lack of school budgets to support the program. (Richard Floyd, Derrah, 1995 : Abstract)

Training is a process of helping others to acquire skills, knowledge, experience, and the means to solve problems. Training should encourage the development of self confidence and the actualization of the person to prepare for the job and prepare for encounters with new problems, which is the process of life long education. (Noi Sirichote, 1981 : 6-7) It is a tool in human development and serves to safeguard the world. The training for EE programs shoul stress realization and awareness of environmental development. (Vinai Veeravatnanond and others, 1977 :

12) Development of attitude and realization towards the environment will depend upon the process of learning and training of EE. (Environmental Development Circle, NA date : 48.15) Furthermore, EE should be stress local problems so that the people in the community will be stimulated and encouraged to come together to find an appropriate solution. The students should also be partners in the process of learning in order to practice leadership in serving the school and community. (Schmieder, Allen A., 1997 : 30) Education on environment or EE should involve all people and organizations (UNESCO, 1992 : 13)

The great environmental problems in Thailand are the deterioration of natural resources and the environment due to human activities (Joseph, 1975 : 35 ; Vinai Veeravatnanond, 1994 : 123) Mangrove forests, which are important forest resources, have also deteriorated through human activities, which have not adequately valued these resources. The expansion of community and industrial sites has caused major changes in the balance of the ecosystem food chain and foodweb, including a continual decrease in mangrove areas. (Nittharatana Paphavasit, 1995 : 80 ; Sanit Aksornkoae, 1995 : 97)

A survey of mangrove forest in Samutprakarn reported 12,030 Rai in 1990 (Department of Land Development, 1990 : 60) Due to the promotion of industrial investment within the province, large numbers of plants and factories have spread over the area, including the sea coast. One such investment, crayfish farming, has become a great destroyer of the mangrove forest. The Land Sat-5 (TM) Geocoded (1:50,000 scale) in 1996 indicated that the remaining mangrove areas cover only 1,857.50 Rai (Tongchai Charupat and Jirawan Charupat, 1997 : I–965). This is largely due to the fact that forest areas in Samutprakarn have not been protected by laws governing National Parks. (Department of Land Development, 1990 : 60)

To solve the deterioration of mangrove forests as described above, the "out door education" for youngsters will be a key process which coincides with the UNESCO-APEID program promoting EE as the means for learning about the environment. (Fien & Tilbury, 1996 : 16). Through EE, students have a chance to learn and practice in the fields. This direct learning and experience can effectively change attitudes and behavior of the students. (Falk & Balling, 1982 : 22-28, Bentley, 1982 : 2900A-2901A)

The researcher proposes a solution to solve the existing mangrove problems through a non-formal educational program focusing on the outdoor training of environmental education on mangroves for lower secondary school students. The existing local problems will be organized into learning activities which emphasize participation and partnership among students and teacher, or educators, to develop knowledge, attitude and skills in practices concerning conservation and restoration of the mangrove forests. This teaching learning format differs from the traditional teaching-learning as presented in the following table :

Table 2. Teaching – learning format on conservation and restoration of mangrove forests.

Organization	Activities	Teaching – learning process	Target group
Had amara Aksornlak vitaya school, Muang district Samutprakarn.	– Lesson plan – Extra curricula activities – One decisional year	– Integrated into environmental science curriculum – Regular learning time and weekend – Content/activities 1. Ecosystem survey 2. Interview of community members 3. Analysis of the effects of mangroves 4. Growing plants. 5. Science projects	Higher secondary school students

Table 2. Teaching – Learning format on conservation and restoration of mangrove forests. (Cont.)

Organization	Activities	Teaching – learning process	Target group
Banlam School Banlam district Phetchaburi	– Lesson plan – One educational term (sermester)	– Integrated into environmental science curriculum – 2 session/week – Content/activities 1. Physical features of mangrove forests 2. Organisms in mangrove forests 3. Adaptation of plants and animals in mangrove forests 4. Relationship among organisms in mangrove forests 5. Importance of mangrove forests	Primary school students

Saklasutira upatum secondary school is a school under the Department of General Education located at Nagleu, Prasamutjedee district, Samutprakarn province on 34 Rai of land. Most of the school area is mangrove forest, which is composed of more than 22 species of plants. (Science section, NA date : 29). There are large numbers of marine animals, land animals, and birds, making this site a good and appropriate site for biological studies, research, and restoration of the sea coast forest. Currently government sectors and private sectors in the province attend to and support the restoration of mangrove forests, (Department of General Education, 1997 : 6-7)

but the school requires practical curriculum and activities for training the students about mangrove forests.

According to the Constitution of the Kingdom of Thailand (1997) Section 79 encourages the integration of existing environmental problems at the local level into the organization of the teaching-learning process through an emphasis holistis relationships, interactions, and the seeking of solutions. It is recommended that EE programs initially address local problems and then outreach to other environmental issues. Such a program structure promotes the role of learners by utilizing each individual potential within the local community to participate in conservation and environmental development and culture.

It is the intention of the researcher to develop a training curriculum on mangrove forests for lower secondary school students in Samutprakarn province by using students in Saklasutira upatum school as a pilot project before expanding the implementation of the project to other schools.

2. Objectives

The purpose of this study is:

1. To develop a training curriculum on mangrove forests for lower secondary school students in Samutprakarn province by stressing child- centered learning and direct experiences in the actual local environment.

2. To create a training curriculum on mangrove forests which can then be implemented in other lower secondary schools.

3. Results from the study

1. Attainment of a training curriculum model on environmental education of mangrove forests for lower secondary school students that stresses a child-centered approach.

2. It is originated and created by those who are concerned with the training curriculum; the learning site is the real situation in the local field or outdoor study.

4. Scope of study

The scope of this study encompasses:

To develop a training curriculum on mangrove forests at Samutprakarn which includes theory and practical components as follows:

1. Theory component: Discussion of the mangrove forest environment including basic knowledge of EE, the mangrove forest ecosystem, the advantages and value of mangrove forests, problems and status of mangrove forests, and methods of mangrove forest conservation.

2. Practical component: Interaction with educational stations and outdoor field work consists of:

2.1 Path walk stations including a *Nypa plam* community, *Avicennia* community, taup-tap *(Derris trifoliata)* forest and marine animal community.

2.2 Mangrove plant station as the point to collect mangrove plants, such as *Avicennia Rhizophora,* mangrove and Sonnera tree for cultivation and distribution.

2.3 Mangrove nursery station to demonstrate and collect mangal trees and to prepare young plants for distribution.

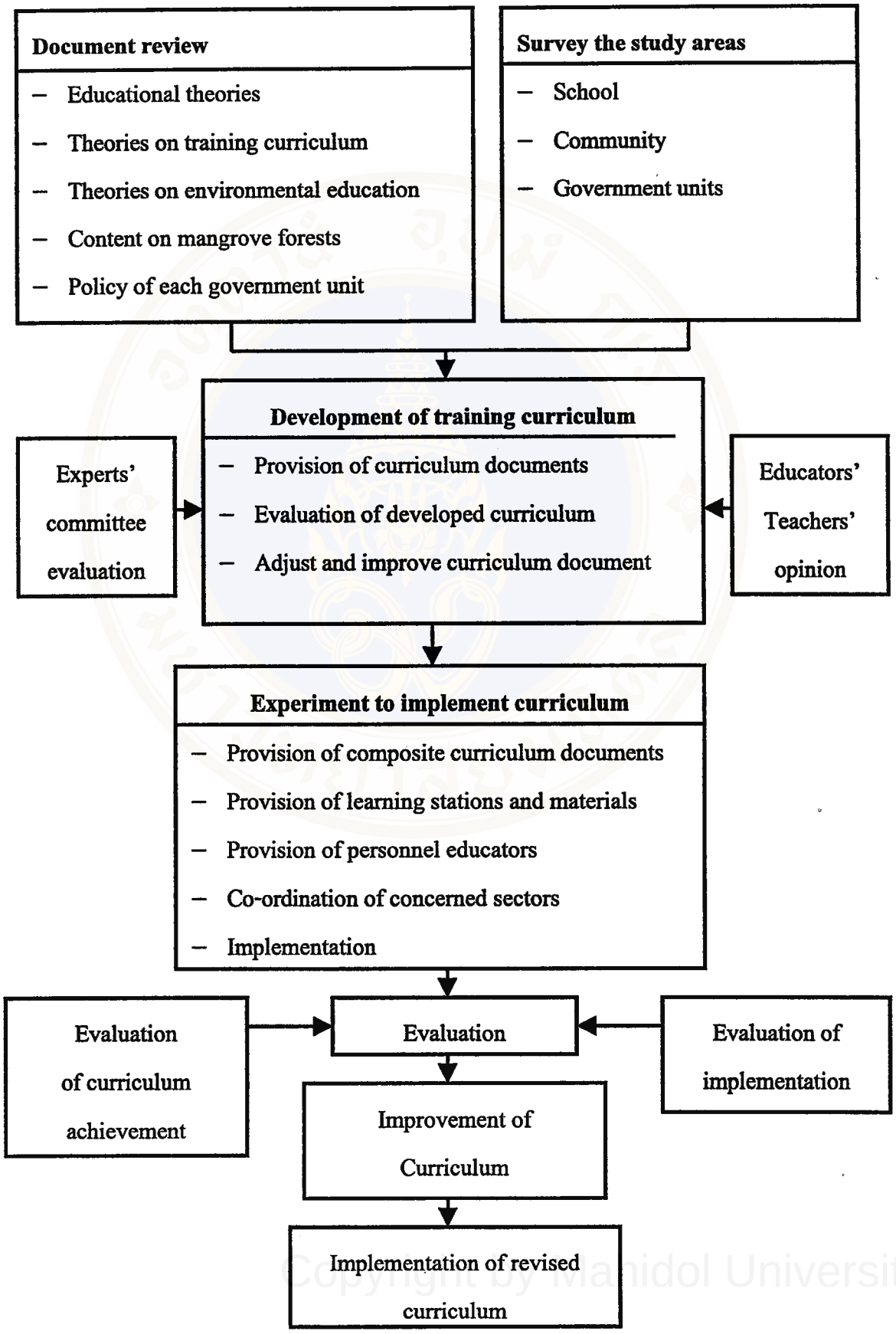
2.4 Experiment station to investigate the physical structure, soil, water, and temperature of mangrove forest areas.

2.5 *Phizophora* forest station as a demonstration station to study the growth of *Rhizophora* and problems of growth.

2.6 Bird watch station as the location to observe and study the life of sea birds within the ecosystem.

2.7 Outdoor field practices in mangrove forests in communities along the shores of rivers, channels, and at the mouth of the river near Prachulchomklao Port.

5. Conceptual Framework



6. Definition of Terms

Training curriculum means a specific course of study on mangrove forest for training the lower secondary students to practice in the field and learning stations. The curriculum consists of basic knowledge of the mangrove forest ecosystem, advantages and value of mangrove forests, status and problems of mangrove forests and methods of mangrove forest conservation.

Learning station means the natural media for activities and practice in the field, consisting of path walks along the muddy shores of mangrove forests, nursery for sea coast plants, experimental station, mangrove forest station, bird watch station, and outdoor activities station.

Knowledge means the results of learning and training. Knowledge is measured and evaluated through the administration of tests on the subject matter.

Attitude means degree of feeling and affection compelling one to react in favor of or against the situation. In this study the researcher intends to assess the degree of acceptance or resistance toward EE and the conservation of mangrove forests program by application of a Likert's rating scale.

Practices means activities, participation, and partnership in the training program on mangrove forests.

7. Significance of the study

It is expected that the output of the training program will be:

1. The developed training curriculum on mangrove forests which the Department of General Education can apply in other schools of the sea coast of Thailand.

2. The promotion of the youngsters' and the public's realization and awareness of conservation and restoration of mangrove forests.

3. The training curriculum for youngsters and the public in Samutprakarn province.

4. A site for camping and environmental study of mangrove forests in Samutprakarn and nearby provinces.

CHAPTER II
LITERATURE REVIEW

Mangrove forest are of economic and social importance in the Kingdom of Thailand. At present, mangrove forests have been destroyed and are rapidly deteriorating. Now is the critical time to implement educational processes as a solution in order to build up a sense of conscientiousness and awareness toward mangrove forests as the public and students participate in protection and conservation of mangroves. The implementation of theories and principles of environmental education (EE.) to deal with existing problems in the field as the content of short term training emphasizes participation and partnership in group processes; practice is important to solve the real problems in the field by means of EE in order to develop the students' knowledge, attitude, and skills in practicing mangrove development.

The process of constructing the training curriculum used in this study relies on the curriculum construction theories of Taba (1962:12), Saylor, Alexander Lewis (1981 : 30), Oliva (1992 : 169) and Sangad Autranan (1984 : 35) integrated with the theory of training curriculum in EE by UNESCO (1978 : 3). All of these theories were integrated into 5 steps in the mangrove training curriculum. The steps are: study of the basic information from databases, construct the training curriculum, documentary study, experiment to use the curriculum, and evaluation carried out with the assumption that environmental education should take place in the field and promote the well-being of the environment.

The developed training curriculum on mangrove forests is based on the defined structure, elements of the curriculum, processes, and evaluation. The literature review concerns:

2.1 Theory and thoughts on education

2.2 Theory and thoughts on environmental education

2.3 Mangrove forests as natural resources

2.4 Development of training curriculum on EE.

2.5 Review of previous studies

2.1 Theory and thoughts on education

2.1.1 Knowledge

1) Meaning : According to the Dictionary of Education, knowledge is defined as the accumulated facts, truths, principles, and information to which the human mind has access. (Good 1973 : 325) Lexicon Webster defines it as the act, fact, or state of knowing ; all that has been perceived or grasped by the mind ; learning ; enlightenment ; the body of facts accumulated by mankind. (The Lexicon Webster Dictionary, 1997 : 531) In addition, Prapapen Suwan (1997 : 10) concluded that "knowledge" is the basic behavior of the learner which is accumulated through thinking, seeing, hearing, or remembering. Knowledge in this sense concerns the definition, or meaning of facts, principles, theory, law, structure and methods of solving problems. Likewise, Bloom (1971 : 271) defines "knowledge" as the specific issue or general thought, which recognizes the method, process or situation through memory.

Therefore knowledge means all facts regarding events, principles, things, or people in the mind of humans which has been accumulated, remembered, and expressed in the behavioral memory and can be observed or measured.

2) Level of knowledge

Bloom and others (1956 : 10-24) divided the cognitive domain into six levels ranging from simple to complex:

2.1) Knowledge as the capacity of human memory; this level of knowledge can be seen from the ability of the person to select from his/her memory.

2.2) Comprehension, or the ability to communicate with other people to understand their intentions and thoughts.

2.3) Application, or the ability to apply what he/she has comprehended from memory to effectively solve new problems. This is not imitation from past experiences, but originates from his/her own ability.

2.4) Analysis, or the ability to analyze or break down the issues or problems into parts or pieces.

2.5) Synthesis, or the ability to integrate all related and involved pieces together to form new concepts or issues.

2.6) Evaluation, or the ability to assess and evaluate according to acceptable criteria or standards.

3) Knowledge Assessment.

There are a number of instruments to measure knowledge depending upon the goals and objectives to be measured and the design of the user, but most of the instruments are tests which have been used widely. (Boontham Kitpreedaborisuit, 1988 : 21-25)

1) In psychological testing, there are three types of tests:

1.1) Achievement tests to assess knowledge and understanding, or the cognitive domain, which can be divided into :

1.1.1) Teacher-Made Test or locally constructed test, either objective or of the essay type for local classroom use. It is an unqualified test.

1.1.2) Standardized Test, or a test for which content has been selected and checked empirically, for which norms have been established, for which uniform methods of administering and scoring have been developed, and which may be scored with a relatively high degree of objectivity.

1.2) Aptitude Test, or a test designed to indicate a person's potential ability for performance of a certain type of activity. This type of test can be divided into :

1.2.1) Scholastic Aptitude Test, or a test used to predict the facility with which the individual will progress in learning academic school subjects.

1.2.2) Specific Aptitude Test, or a test designed to measure some special ability or restricted group of capacities.

1.3) Personal-Social Test, a measure of social aptitude

2) Question-Answer type test, there are two types of tests:

2.1) Essay Test, or the traditional type of examination in which the subject or examinee is asked to discuss, enumerate, compare, state, evaluate, analyze, summarize, or criticize.

2.2) Short Answer and Multiple Choice Test, or a series of questions to which the subject is asked to respond by writing a brief answer and a recognition type of test in which the subject is asked to choose for each item the one correct or best answer from several suggested answers, respectively.

In this study the Achievement Test in the form of a multiple choice test is used to measure knowledge and cognition according to Bloom's principle.

2.1.2 Attitude

1) Definition and meaning

According to the Dictionary of Education, attitude is a readiness to react toward or against some situation, person, or thing, in a particular manner, for example, with love or hate or fear or resentment, to a particular degree of intensity. (Good, 1973 : 48-49) Also, Thurstone (1967 : 77) stated that attitude is the total feeling of human prejudice, thinking, fear or resentment to a particular subject that is expressed in words. The attitude of an individual can be measured by asking opinions. Anastasi (1967 : 543) and Hillgard (1962 : 214) defined attitude as an acceptance or rejection toward a particular issue, or event, and a readiness to respond with prejudgment.

It can be concluded that attitude is a human behavior stemming from cognitions of past experiences that he/she can express in term of acceptance or rejection.

Attitude is an element of the affective domain. Attitude is formed through emotions an individual has experienced since first touch and response and which has developed in value until it has become habit. Attitude is composed of three elements:

1. Cognitive, or belief component
2. Feeling, or evaluative component
3. Behavior component

2) Attitude measurement

Since attitude is composed of three elements, the attitude measurement must measure all of the components in a holistic manner.

2.1 The principle to measure the attitudes of any individual should include the following components: (Boonttham Kitpreedaborisuit, 1974 : 222)

2.1.1 Content: the content to be measured must be the stimulus provoking a response that can be expressed and is measurable.

2.1.2 Direction: the direction of the attitude can be expressed in continuous linear form from left to right or negative to positive; the zero point is in the middle of the line.

2.1.3 Intensity: the response that is expressed must be either acceptance or rejection of the stimulus, which is indicated by the frequency or intensity on the line. High intensity means a feeling or opinion of acceptance or rejection of the content to a degree more than moderate or low intensity.

2.2 Instrument to measure attitude

Attitude test, a test to measure the mental and emotional set or pattern of likes and dislikes held by an individual or group, often in relation to controversial issues, personal adjustment, etc. which is normally on a rating scale of opinion or response. The test is composed of two parts : the attitude statement and the answers on the rating scale. The popular attitude tests are Thurstone's type scale, Likert Scale, and Osggod Scale. Every type of scale has weak and strong points; no test is complete and absolute in and of itself. Therefore tests must be very carefully selected in order to implement the type that is appropriate to the research.

The Likert scale is most appropriate for this study based on these assumptions : (Sawasdi Sukontrungsi, 1972 : 290)

1. The answers to the questions or statements are stable.
2. The total response of each individual is in linear form.
3. Each response represents only one subject or issue to measure.

On Likert's rating scale, the statements should have equal weight between positive and negative statements. Normally there are five degrees of measurement ranging from least to most or from most to least. The average of the

total response will indicate positive or negative attitude toward the content to be measured.(Anastasi, 1967 : 482 – 485)

Likert's rating scale will be applied in this study.

2.1.3 Practices

1) Practice means to do something repeatedly in order to learn or acquire proficiency, mental or physical action for the purpose of learning or acquiring proficiency; the doing of something often as an application of knowledge and cognitive domain as well as attitude. The practical behavior can be measured if expressed in terms of action, but the process which stimulates the practical action requires time and many steps of decision- making. (Prapapen Suwan, 1977 : 20-21)

2) Practice measurement or practice test

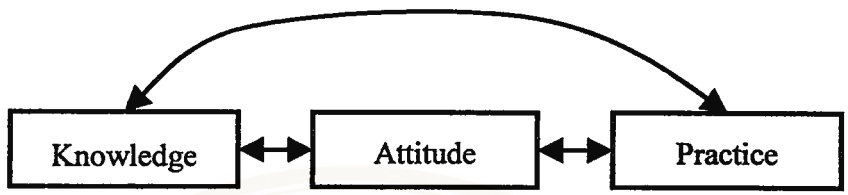
A test primarily intended to afford practice or drill in the given field rather than to measure knowledge or achievement, commonly used in arithmetic, algebra, languages and other subjects; sometimes used as a measure of attitude for some purpose. Checklists and Rating Scales are commonly used in test of practices (Sunan Solkosum, 1972 : 139 – 140)

A practice test will be used in this study in the form of a questionnaire concerning participation and partnership in conservation and restoration of mangrove forests on the part of the students.

Relationship between knowledge, attitude and practice

Knowledge, attitude and practice are closely related behaviors which occur simultaneously (Suchart Somprayoon, 1997 : 54) Prapapen Suwan, (1997 : 75) suggested that knowledge alone does not insure an individual will practice according to his/ her knowledge. Attitude operates in conjunction with an individual's learned knowledge. Jintana Unipan (1984 : 31) stated that information is the principle knowledge and that related imagination includes experiences which are fundamental to human thinking, consideration, and decision making originating in constructive practice. Therefore reinforcing knowledge would promote practice directly or

indirectly. In the case of indirect means, attitude will be the middle joint as shown in the diagram :



2.2 Theory and thought on Environmental Education (EE.)

2.2.1 Meaning of Environmental Education (EE.)

According to the UNESCO (1977 : 75) Conference of the International Union for Conservation of Nature and Natural Resources, EE is defined as the process to develop awareness and attitude toward the value of the environment and its relationship to human lives including culture and biodiversity, with the aim of maintaining the quality of the environment. Also, Stapp (1981 : 1) stated that EE is the process to develop human awareness of the environment and related problems; EE targets attitude, reinforcement, skills, and practice in order to restore the environment through individual or group forces.

Laddavul Kunhasuwan (1991 : 2), Temduang Ratanatasanee and Varaporn Srisupan (1991 : 101) defined EE as an educational process to develop the conscientiousness of students and public in order to make them aware of environmental problems and have a sense of responsibility to join and solve the problems together. EE includes an emphasis on knowledge and understanding of the environment and the relationship to human life in order to develop the quality of the environment and better living of man. Likewise, Vinai Veeravatanond and Bancheun Seepunpong (1996 : 15) defined EE as an educational process that emphasizes knowledge of the physical environment and social environment, which can change the effects on human life, attitude, and behavior.

In conclusion, EE means an educational process that emphasizes the development of awareness of the students and the public toward environmental problems. EE encourages them to share responsibility and partnership and to

participate in restoration and solve environmental problems together, hand in hand, in a sustainable manner.

2.2.2 Principle of Environmental Education (EE.)

According to the Belgrade charter, the principles of EE are: (Vinai Veeravatanond and others, 1997 : 6)

1) EE must deal with all of the concerned natural or man-made environment, including ecology, politics, economics, technology, social policy, law, legislation, culture and ethics.

2) EE is a lifelong process.

3) EE should be interdisciptinary.

4) EE should emphasize co-operation and participation in the protection of the environment through finding solutions to environmental problems.

5) EE should consider global problems, while at the same time attend to local and regional problems.

6) EE should stress the present as well as the future situation.

7) EE should consider the total progress and development with their proportional effects on the environment.

8) EE should encourage the people to appreciate the value and the necessity of co-operation and participation in protecting the environment and solving the environmental problems either at the local, national or global levels.

These principles have been the fundamentals of this study and of the developed training curriculum on mangrove forests.

2.2.3 Goals and Objectives of EE

Environmental Education Goal

According to the Belgrade workshop, the agreements had been set "to encourage each individual awareness in the environment and environmental problems

and to promote knowledge, attitude, and readiness to participate in and be in partnership for public problem- solving" (the Belgrade Charter, 1976 : 62).

Environmental Education Objectives

1) Awareness : To encourage awareness of individuals and society to heighten sensitivity to environmental problems.

2) Knowledge : To encourage knowledge and experience of the people toward the environment.

3) Attitude : To encourage positive attitudes on the part of individuals and society towards the environment in order to promote co-operative effort to protect and improve the environment.

4) Skills : To encourage skills of individuals and society to analyze and solve environmental problems.

5) Evaluation ability : To encourage evaluation by the people to assess the environmental situation and study the function of projects in terms of ecology, politics, economics, social policy, ethics and education.

6) Participation : To encourage the people to co-operatively participate in community activities (UNESCO, 1978 : 20-27)

The Tbilisi Conference in 1977, the Belgrade charter and the Rio Earth Summit in 1992 have confirmed these objectives. The Belgrade Charter Agenda 21 stated that "The aim of EE is to develop quality of life of the people in awareness, close relation with the environment and concerned problems, encourage knowledge, attitude, reinforcement and co-operative work together either on an individual or group level in order to solve the social problems concerning the environment and prevent the development of new problems." (UNESCO, 1980 quoted in Vinai Veeravatnanond, 1976 : 2) The Tbilisi conference in 1977 stated the objectives of EE as : (UNESCO, 1980 : 26)

1) To encourage the global population to be aware of conditions and relations among economic, social, political, city and rural ecology.

2) To encourage the global population to develop knowledge, value, positive attitude and skills in order to protect and improve the environment and prevent environmental problems.

3) To build behavioral patterns toward the environment either on an individual or social level.

In brief, The objectives of EE are: development of environmental knowledge, understanding, attitude, skill and responsibilities; knowledge regarding how to analyze the problems related to the environment; develop and increase awareness of the people toward the environment and promote their ability to effectively co-ordinate and participate in social problems in the present and future. The Belgrade charter will be the main theme of this study.

2.2.4 Environmental Education Organization

According to Tbilisi (1997), EE should be organized around these issues (Vinai Veeravatananond and others, 1997 : 10):

1) EE considers the environment in its totality, i.e. ecological, political, natural, technological, sociological, aesthetic and built environments.

2) EE is a life long educational process from elementary school through every grade of the informal or formal educational system.

3) EE is interdisciplinary and requires information and insights drawn form many different disciplines.

4) EE considers the global as well as the local environment. Since the world is a set of inter-related systems, there is a need for a world perspective on environmental issues.

5) EE focuses on current and future perspectives on environmental conditions.

6) EE recognizes the value of local knowledge, practices and perceptions in enhancing sustainability.

7) EE is a response to the challenge of moving toward an ecologically and socially sustainable world.

8) EE is concerned with the interaction between the quality of the biophysical environment and the socio-economic environment.

9) EE supports relevant education by focusing learning on the local environment.

10) Action is both a vehicle for and an outcome of EE.

11) EE develops awareness of the importance, beauty and wonder that is and can be found in these aspects of the environment.

12) EE emphasizes participation in preventing and solving environmental problems and revokes the passive accumulation of information about the environment. It should foster and arouse a sense of personal responsibility, greater motivation and commitment towards the resolution of the environmental situation.

2.2.5 Strategy in teaching EE

Karl Schwab (Schwab, 1983 : 8-12) proposed an effective teaching EE which includes:

1. Outdoor learning or field practices which open the opportunity for students to have direct experiences.
2. Role playing and simulations to train the students on decision-making.
3. Problem solving methods which train the students to develop decision- making skills.
4. Value judgement which trains the students to recognize the value of the natural quality of the environment.
5. Lecture method for basic knowledge and theory background.
6. Discussion method which trains the students in brain storming and opinion formation.

Vinai Veeravatananond (1987 : 155-157) recommends the methods of teaching EE as follows:

1. In terms of outdoor education and field studies in and around the school or in the market and in the community, the teachers must prepare carefully to determine the learning activities which will promote the goals and objectives of EE.

2. Movies or videotape application
3. Color slides with careful description and commentary
4. Transparency implication
5. Module simulation
6. Invitation to experts to give special lectures
7. Experiments in the classroom or in the field
8. Direct interviews with experts which require advanced planning and agreement
9. Special activities and exhibitions concerning the environment within the school, community and global context as needed
10. Group or individual reports
11. Voluntary debate and contests
12. Role playing
13. To take advantage of the opportunity at appropriate times and events

The key to successful EE is the classroom teacher. If teachers do not have the knowledge, skills and commitment to integrate environmental issues into their curriculum, it is unlikely that the students will become environmentally literate.

2.3 Mangrove Forest resources

2.3.1 World famous scientists have defined the meaning of mangrove in many ways. One example is the plant geographer Schipmper (1903) who defined "mangrove forest" as the community of plants that grows along the sea shore, the river mouth or gulf where the tidal zone reaches, which Schimper called a "tidal forest". In contrast Du (1962) defined "mangrove forest" with two wider meanings; first it means plants community that is composed of a diversity of plants of the evergreen species which require the same environment, and second it means plant communities that grow along the gulf and sea shore of tropical regions, mostly composed of Rhizophora, which is of economic importance, and some others species seattering together (Sanit Aksornkoae, 1989 : 2).

2.3.2 Mangrove forests in Thailand are distributed along the east coast, central region, and southern coast. The latest information read from the LANSAT satellite image in 1996 and a survey of the land revealed that the area of total mangrove forests is about 1,047,390.0 Rai. Most of the mangrove forests are in the southern sea coast on a land area of 286,972.50 Rai or 85.2% of the total from the Gulf of Thailand and in the west coast against the Andaman Sea. In the eastern coastal region, mangrove forests cover about 79,112.50 Rai or 14.3% and in the central region or upper Gulf of Thailand, there is only 34,056.75 Rai or 0.5% of the total. (Thongchai Jaruppat and Jirawan Jaruppat, 1997 : 1-9 (5))

2.3.3 Mangrove Ecosystem

Mangrove forests are a unique ecosystem which can be found only in the tropical region sea-shore in the tidal zone. Mangrove ecosystems and life zones have a specific ecological structure and function. In this study the ecological structure will emphasize the function of energy flow within the food chain and foodweb. (Sanit Aksornkoae, 1989 : 110)

2.3.3.1 Ecological Structure of the Mangrove Ecosystem

The biological components of the mangrove ecosystem are :

2.3.3.1.1 Producers

2.3.3.1.2 Consumers

2.3.3.1.3 Decomposers

2.3.4 Advantages and Importance of Mangrove forests

Mangrove forests are not well understood and recognized for their value and importance among the public. Many people still have a concept of mangrove forest as land forests in general. They have not seen the muddy tidal zone of the sea-shore, so they lack knowledge of the mangrove, Rhizophora, and Nypa palm. In fact, the mangrove forest is a wealthy shelter of sea-shore animals and sea-birds besides the most valuable wood of Rhizophora which is excellent for charcoal. Mangrove

forests help the sea-shore from soil erosion due to the high tide of the marine water and strong wind and waves.

The Department of Environmental Quality Promotion (1994 : 4) stated the advantages of mangrove forest as:

1) Ecological importance
2) Social and educational importance
3) Economic products

2.3.5 Problems and current status of mangrove forests

The deforestation of mangrove forests is due to: (Sanit Aksomkoae, 1989 : 176-184)

1. Fishery
2. Mineral mining
3. Agriculture of rice fields
4. Expansion of community
5. Seaport construction
6. Highway construction and high voltage electricity
7. Industrial factories and electricity power plants
8. Water way trench digging
9. Salt-farming
10. Over deforestation

Related mangrove forest problems are:

1. Explosion of population and national economic development
2. Ineffective law enforcement on the part of the National Park Service because most mangrove forests are declared National Parks
3. Unclear definition of planning and policy for conservation of mangrove forests
4. Ineffective law enforcement on land use of mangrove areas, especially concerning the concession of mangrove forests
5. Invasion and deforestation carried out by influential outlaw groups

6. Shortage of government officials to protect the mangrove forest areas

7. Insufficient knowledge and understanding on the part of the public concerning mangroves and conservation of mangrove forests

Land-use in total includes:

1) Total mangrove forests areas 1,047,300.00 Rai
2) Shrimp – farming 418,736.75 Rai
3) Community living areas 55,002.50 Rai
4) Unclassified land-use areas 806,670.75 Rai

The land- use of mangrove forest is summarized in Table 3.

Table 3 Land- use of mangrove forests in 1996

Land-use	Conserved (Rai)	Economic zone A	Economic Zone B	Total (Rai)
Mangrove Forest	147,174.50	810,711.00	89,504.50	1,047,390.00
Shrimp-farming	27,144.00	143,292.50	248,300.25	418,736.75
Community settlement	2,296.00	6,047.75	46,658.75	55,005.50
Others	90,123.00	188,005.00	428,542.75	806,670.75
Total	266,737.50	1,248,056.25	813,006.25	2,327,800.00

Source : Yod Keereerat, 1997 : V-13 (2)

2.3.6 Planing and policy of mangrove management:

The Department of Policy and Environmental Planning (1996 : 43) declared the mangrove policy and management as:

1. An effective policy of mangrove administration should be a systematic and continual process to:

1.1 Improve and clearly define the boundary of mangrove forests on the Gulf of Thailand and on the Andaman Sea.

1.2 Urge provincial planning for the management of mangrove forests and the connected areas behind the mangrove forests, in order to benefit from the advantages of these areas while minimizing the effects to the environment.

1.3 Strong control and law enforcement towards illegal uses of mangrove forests and withdrawal of the concessions.

1.4 Define the scale of protection in order to prevent the deterioration of mangrove forests.

2. Urgent to improve and restore the deteriorated mangrove forest:

2.1 Amend the laws and regulations concerning conservation of mangrove forests and strictly reinforce these laws.

2.2 Urge and promote private sectors to participate in the restoration of mangrove forests and become partners with the Department of Forestry to develop the waste lands that have been spoiled and damaged by shrimp-farming.

2.3 Promote the planting of pine trees to replace and restore deteriorated areas.

Countering the problems of mangrove deterioration is difficult due to the public's lack of knowledge about mangroves and the diversity of plants along the sea-shore which are different from land forests in general. Another weak point is the lack of information and data bases of mangrove forests and networks. The urgent process to recover the mangrove from deterioration is emphasized in the national plan to protect and to restore the mangrove forests. (Sanit Aksornkoae, 1998 : 206)

2.3.7 The restoration and development of mangrove forests.

Yod Keeveerat (1997 : V-13) suggested that:

1. It is important to encourage knowledge and understanding of the value of mangrove forests on the part of the public and those people who have used or consumed the products of mangrove forests. There are some organization such as NGOs and members of some communities in Trung province who are now negotiating to reforest the mangrove areas.

2. The increase in population and parallel decrease of forests indicates that law enforcement and forest management have failed due to the low education level of the people. In Japan and South Korea the increase of population and increase of forest areas have occurred simultaneously.

3. The lack of commitment of the cabinet ministry regarding mangrove policy in 1987 opened the gap for outlaw groups to take advantage of mangrove areas in an unhumanitarian manner.

4. Unclear boundary bench-mark of mangrove forest and conservation areas opened the opportunity for invaders and outlaw groups.

5. Unclear definitions of management and responsibilities towards mangrove protection and restoration has complicated management programs.

6. There has been a failure on the part of government officials to carry out their duties and co-ordinate their jobs.

7. There has been a failure of laws, regulations, and law enforcement including a failure on the part of the authorities to promptly carry out their duties.

8. The unjust documentation of land property titles has caused more mangroves to be destroyed and has allowed for the take- over of the lands by invaders and outlaw groups.

9. The deforestation of mangrove forests is increasing without rationalization, thus forests should be replanted to replace cut trees in a 1:2 ratio.

10. The restored mangrove plantation must be properly cared for and protected by all involved authorities and personnel. They must be educated to understand the value of mangrove forests.

11. The promotion and distribution of research work on mangrove forests is important.

12. The establishment of mangrove information centers requires urgent action.

In order to restore and conserve mangrove forests, Sanit Aksomkoae (1989 : 22) proposed to:

1. Urge to replant and restore the remaining areas of mangrove forests.

2. Encourage knowledge and understanding of mangrove forests in order to promote sustainable use and development.

3. Urge to appropriately plan and manage the use of mangrove areas.

4. Apply new technologies in nursing shrimp and shrimp-farming in order minimize the impacts on mangrove forests.

5. Restrict deforestation.

6. Promote participation and co-ordination among government units responsible for protection of mangrove forests.

7. Urge communication and education efforts to the public in order to increase their understanding of the value of the mangrove forests in their communities.

From the researcher's view point, the sustainable development of mangrove forests should begin with students who live and spend their lives in the mangrove areas from lower secondary grades on through high schools. These students can be motivated through direct experiences and training curriculum on mangrove forests. They will learn and have direct experience and skills which will enrich their sense of appreciation, awareness, conscientiousness, and partnership. These students will distribute their concepts, understanding, attitude and awareness of mangrove forests to their parents and the public within the course of natural human relationships and family association. These students are the power groups of organization to promote the restoration, reforestation, and conservation of mangrove forests.

2.4 The development of training curriculum on EE

Training all members of the public is very important. Training everybody breaks down barriers and builds relationships, which is the core strength of the development of the training curriculum on environmental education in this study. The construction of the training curriculum will be based on:

2.4.1 Curriculum Theory

Meaning of Curriculum

Thamrong Bausri (1961 : 64) defined curriculum as an educational experience that schools provide for teaching and training students. Pinyo Sarthorn (1971 : 404) stated that all subjects and experiences that educators planned to teach

students and which develop in the planned direction form a curriculum. Sumit Kunanugorn (1975 : 1-3) defined the curriculum as a program to develop the learners' the ability to know and qualify the framework of national education.

Taba (1962 : 11) stated that curriculum is a plan for the learners to develop knowledge. Pratt (1980 : 455) asserted that curriculum consists of all systematic knowledge and experiences organized for education both within the formal and informal systems. Bobbitt (1981 : 42) defined curriculum as the list of all activities that students must do, practice, and learn during their schooling.

Beauchamp (1981 : 61-62) stated that the meaning of curriculum encompasses two statuses : 1) Curriculum development, the use of curriculum and the evaluation of curriculum, 2) Framework of teaching and learning including documents written for curriculum implementation, personnel and administration, the development of the curriculum process, the implementation and the evaluation. Tanner and Tanner (1980 : 43) defined the curriculum as the accumulation of knowledge and experiences through careful development within schools for the learners to be able to advance their knowledge and experience.

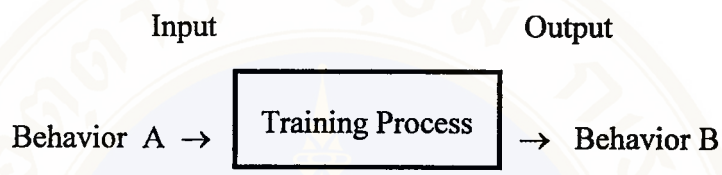
It is concluded that curriculum is a general over- all plan of the content or specific materials of instruction that schools should offer the student in order to qualify him for graduation or certification or for entrance into a professional or a vocational field.

2.4.2 Theory of Training

Amorn Ruksasat and Soraj Sujaritkul (1981 : 239) stated that training is all activities that encourage the competencies of the work force for present and future development of thinking, habit, experience, knowledge and personality. This coincides with Surapol Jantrapat (1986 : 1) who stated that training is a process to develop people with a continual process of education to change behavioral practices and improve knowledge, skills, and attitudes. Similarly, Flippo (1996 : 243) and Beach (1970 : 375) defined training as a process to increase knowledge, skills, and experience in order to equip the person with skills for specific issues and to empower the person to change practical behavior. Good (1973 : 613) stated that training is a

process of helping others to acquire skills and knowledge without reference to any great meaning for the individual who is learning to perform the skills or to verbalize the knowledge. These skills are being performed at the instance of conditioned cues.

In conclusion, training is an educational process to develop knowledge and skills or to change behavior according to the conditions as the input diagram below displays:



2.4.3 Construction of Training Curriculum in EE.

Education and training are the process of helping people to acquire skills and knowledge. Education and training both require curriculum and management but differ in terms of time, budget, and target groups. The construction of training curriculum is based on the following principles:

2.4.3.1 Meaning of training curriculum

Some educators have defined the meaning of training curriculum in many ways, such as:

Jones (1974 : 99) stated that the curriculum is the sum of teaching and training activities which are grouped together into related issues. Krich Ampoch (1997 : 3) and Noi Sirichot (1981 : 48) defined the training curriculum as the content of the subject and the process planned for the trainees to develop knowledge, understanding, and attitude; it can change the trainees' thinking and behavior according to the training objectives.

2.4.3.2 Development of training curriculum

UNESCO (1978 : 3) recommended steps in training curriculum development include:

1. Define the needs of the trainees
2. Define the specific objective of the training program

3. Select the sequence of the content
4. Define the method of training, group of training, time and place for training.
5. Test the training curriculum
6. Implement the training curriculum
7. Evaluate the training curriculum

According to Noi Sirichot, (1981 : 49) steps in the construction of training curriculum should be:

1. Analyze the needs of training
2. Specify the topic and the field of training
3. Organize the sequence
4. Specify the objective of each topic
5. Specify the techniques to be used
6. Specify time and duration
7. Specify the academic personnel or expert
8. Prepare papers and articles carefully.

Preung Kumut (1991 : 12) recommended the following steps for training curriculum organization:

1. Survey the needs of training
2. Specify the curriculum and the academic personnel
3. Specify the place and facilities
4. Specify the activities and time for training
5. Evaluate the training program

Thavatchai Chaijirachayakul (1986 : 121) stated that the most popular curriculum planning is Tyler's emphasis on the learners, society and experts. In this model, general objectives are defined according to the school's philosophy and psychological learning theories. The next stage is the development of the specific objective of the training curriculum and the organization of content and activity sequence followed by an evaluation of the curriculum.

Model of Tyler's Curriculum Development (Oliva, 1992: 169)

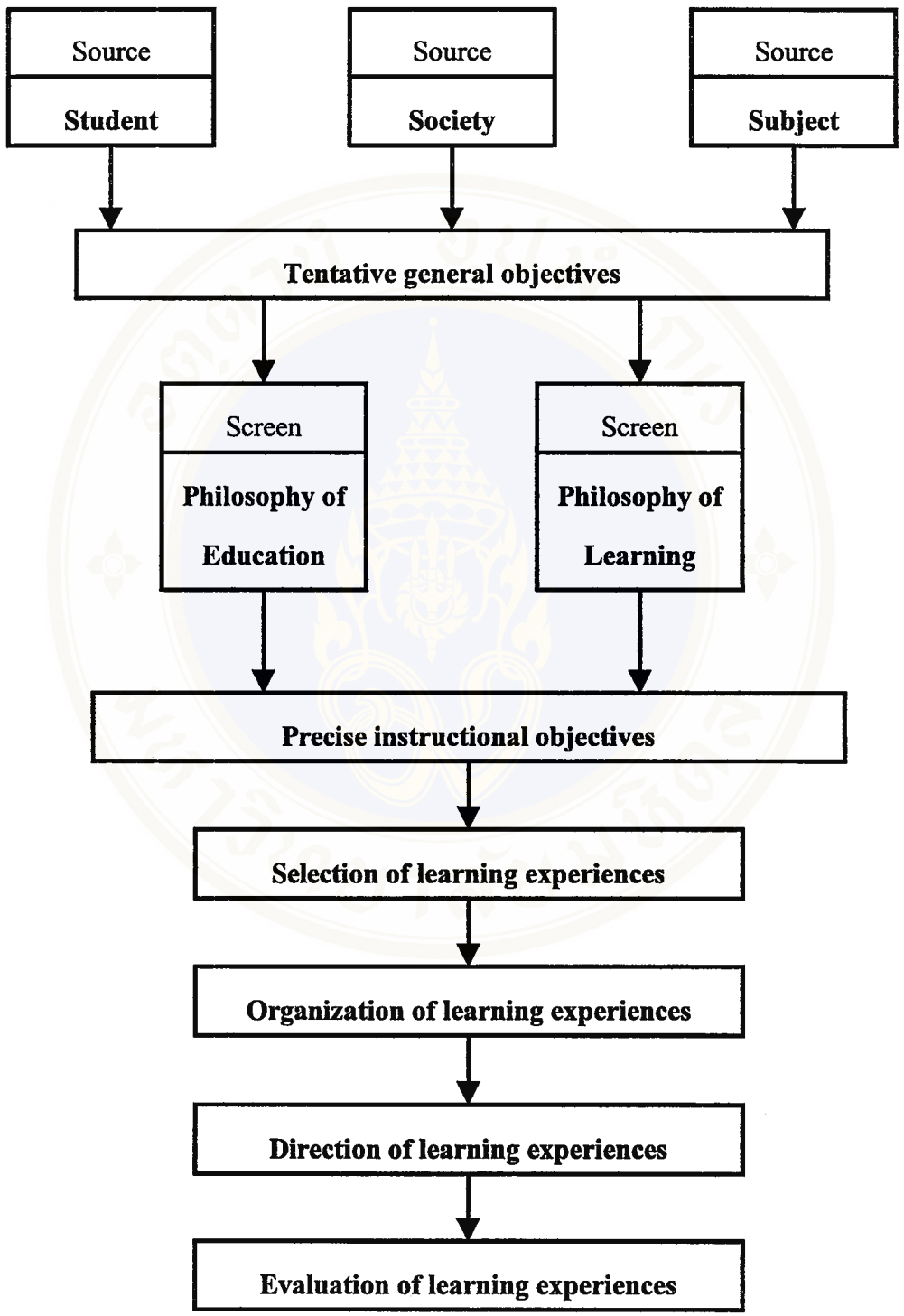


Figure 1 Rationalization of Curriculum by Tyler (expansion)

Steps in curriculum development by Taba (1962 : 12)

1. Survey the problems, needs and social necessity
2. Specify the educational objective of the social needs
3. Select content
4. Organize the selected contents into a sequence
5. Select learning experiences to match with objectives
6. Organize learning experiences into a sequence
7. Specify criteria and method of evaluation.

Saylor, Alexander & Lewis (1981 : 30)

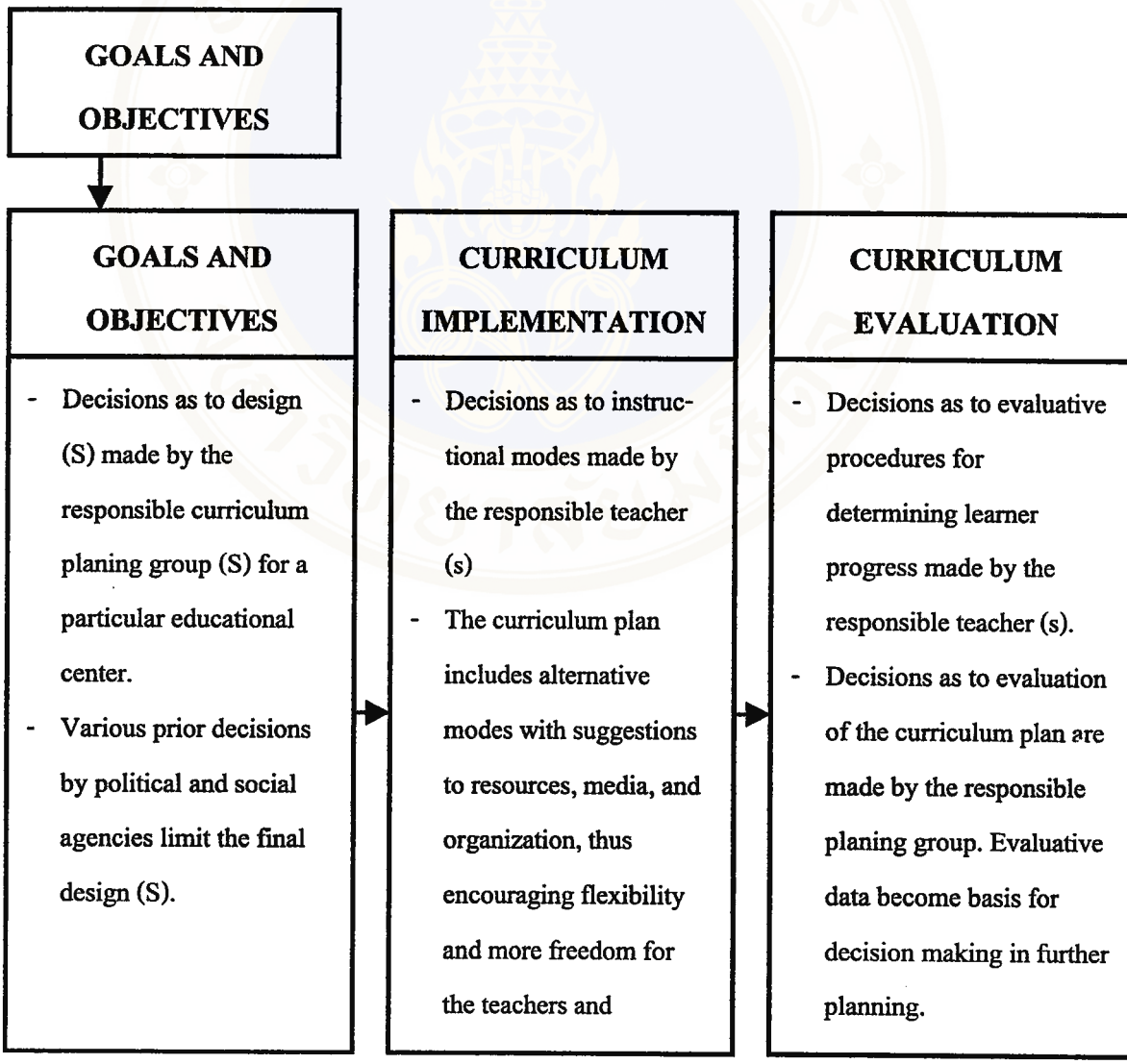


Figure 2 Curriculum Development by Saylor, Alexander and Lewis (1981)

Systematic Curriculum Development by Sangad Autranand (1974 : 35)

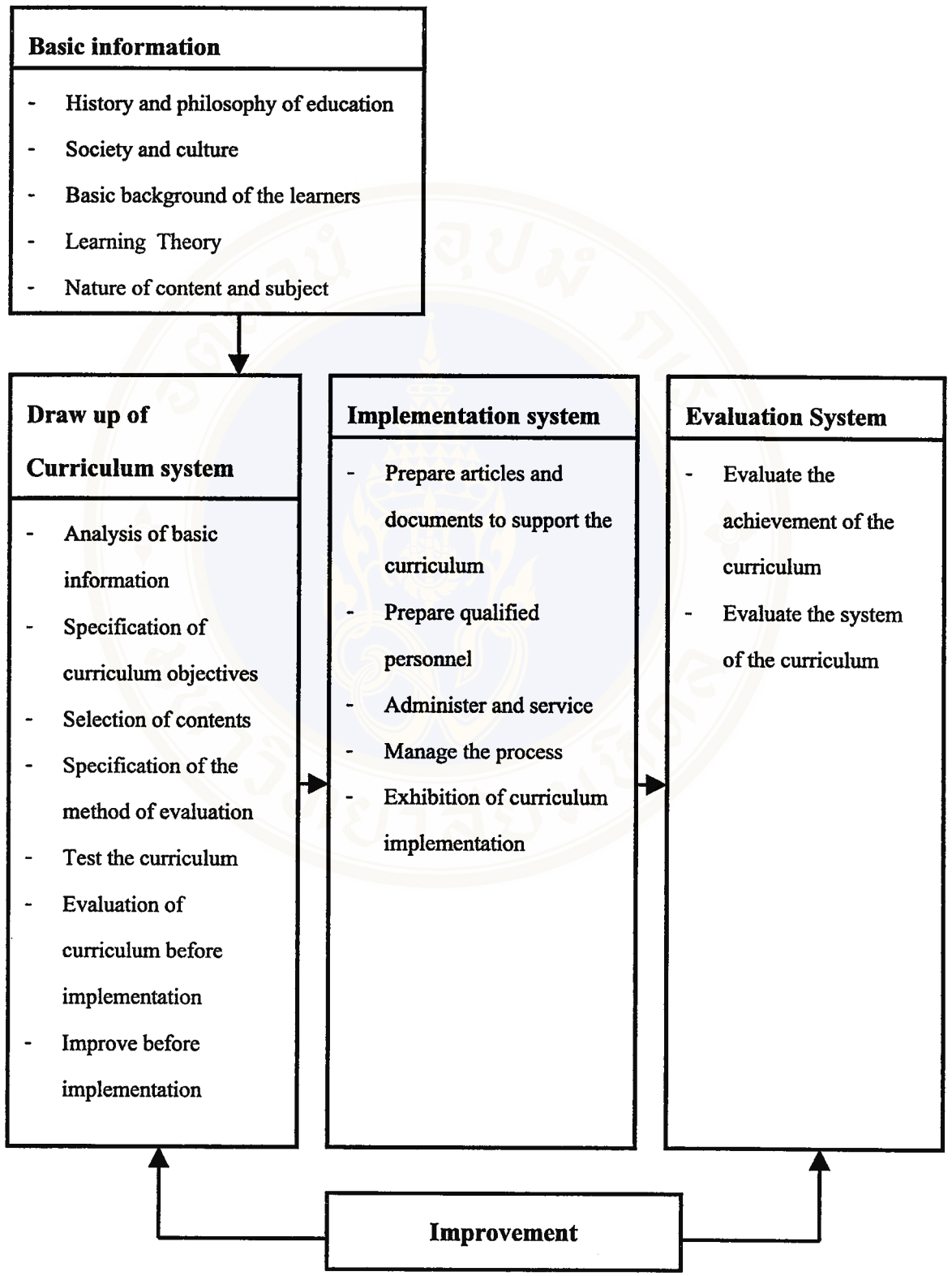


Figure 3 Curriculum Development by Sangad Autranand

The development of training curriculum in brief is composed of:

1. Database and basic information for study and collection
2. Construction of training curriculum
3. Clarification and testing of the training curriculum
4. Implementation of developed training curriculum
5. Evaluation of the implemented curriculum

2.5 Review of previous studies

2.5.1 Development of training curriculum

Suchart Leetrakul (1989 : 180-181) developed curriculum for the pre-schools of construction laborers' children in the Bangkok Metropolitan area by dividing the method into three steps:

Step 1. Documentary study and interview for seeking basic information about the children.

Step 2. The construction of curriculum based on the database collection in order to define specific objectives, content, teaching – learning activities, and evaluation, all of which are approved by an expert committee.

Step 3. Test of the developed curriculum with children to evaluate the efficiency and achievement of the curriculum

The result of the study is the curriculum for pre-school children of construction laborers which is composed of the necessary curriculum, objectives, behavioral objectives, content, teaching – learning activities, and evaluation. This curriculum is flexible to fit the situation and condition of the children in each community.

Sakorn Puttapuan (1991 : 63 – 65) developed a training curriculum to prevent illegal drugs and narcotics for fundamental health and sanitation personnel which was composed of :

Step 1. Documentary study seeking for problems and needs in order to protect against illegal drugs and narcotics and analysis of databases collected.

Step 2. Construction of training curriculum based on the analysis of databases and national health and sanitation policy to specify the objective of the training unit, behavioral objectives, content, activities and training process, and evaluation, all of which were approved by an expert committee.

Step 3. Test of the developed curriculum to find its level of efficiency with the trainees.

Step 4. After evaluation, improve the curriculum for further use.

Vichit Suratreungchai (1991 : 81-83) developed a training curriculum concerning the protection against HIV/ AIDS transmission for elementary school teachers which was composed of :

Step 1. Documentary study, a survey of basic information about elementary school teachers collected through direct interviews.

Step 2. Construction of the training curriculum composed of problems and necessities, objectives, specific objectives, content and training activities, media, and method of evaluation

Step 3. Test the training curriculum with teachers in order to determine the effectiveness and efficiency of the curriculum.

Step 4. Improvement and implementation

Step 5. Implementation and evaluation.

The result of the study of elementary education was a training curriculum to protect against HIV/ AIDS transmission for elementary school teachers.

Somkid Thanareungsakulthai (1990 : Abstract) developed a training curriculum concerning industrial arts for in-service teachers to encourage and increase teaching capacity. The training curriculum was composed of study and analysis and included the problems, the needs, teaching status, construction of training curriculum and approval from an expert committee. The implementation of training curriculum revealed that the teaching capacity of the in-service teachers increased significantly at 0.1 level; the teaching competency after training was higher than before training by about 60%.

Sroythong Sirimongkol (1988 : Abstract) developed a training curriculum concerning the environment for secondary education teachers. It was a case study in Samutprakarn, which was composed of objectives, content, training process and evaluation. The contents were composed of theory and principle of environment and field study and practices. The training process was composed of the lecture method, discussion, case study and field practices. Evaluation was composed of pre-test, testing during the training, post-test, and follow up after training.

Kunawut Ranchan (1989 : A-C) developed and evaluated a training curriculum concerning the conservation of natural resources for young agriculturalists in the formal system of the rural area based on personal background and database along with tests of knowledge about conservation and the environment. The study revealed that training the young agriculturalists on conservation and the environment is a necessity. The training curriculum was composed of objectives, content, learning experiences and skills, and evaluation, and was developed through the co-operative efforts of curriculum experts and non-formal environmental educators.

Sopida Patanaporn (1997 : Abstract) developed and experimented with the developed training curriculum on EE for lower secondary school students concerning the conservation of natural resources along the sea-shore for lower secondary. The study revealed that the training teachers gained more knowledge on conservation of sea-shore natural resources and changed their attitude towards conservation of sea-shore natural resources after training. The results were significant at the 0.05 level.

The review of previous studies reveals that the training curriculum was composed of three main components firstly, the survey and collection of information and databases; secondly, the construction of training curriculum composed of objectives, content, learning experiences, and skills, the process of training, materials and medias, and method of evaluation, thirdly, the evaluation of curriculum implementation.

2.5.2 The environmental education training procedure

Rajabhat Pranakorn Institute established an EE program in 1988 with the goals and objectives of defining resources for research and study of the methods of teaching environmental issues to elementary and secondary students in order to cultivate their awareness and appreciation of the environment.

The Faculty of Environment and Resources Studies, Mahidol University organized a training program in EE for youth on four occasions. The youth were taught conservation of natural resources and the environment in order to cultivate the sense of responsibility towards the use of natural resources and the problems of the environment. Fourty secondary school students joined the five-day training program. The training program was composed of objectives, content, activities and experiences, and materials – medias. Evaluation of each training revealed that the youth gained more knowledge and a better understanding of the environment.

Richard, Floyd, and Derrah (1995) studied the status of EE in secondary schools in the state of Maine in order to evaluate the status of EE in secondary schools and the feeling of teachers toward the status of EE in the state of Maine. Derrah reported that EE did not have official current status in the state of Maine. The researchers felt that EE should emphasize problem solving, partnership, and interdisciplinary work rather than exist as a separate course. It was recommended that the participating teachers should be trained before joining the program. The lack of budget and the lack of time of the participating teachers were the main barriers.

Deborah Simmons (1998) studied "Using Natural Settings for EE : Perceived Benefits and Barriers" to find out which reinforcement in the natural environment encouraged the teachers to use EE. Simmons reported that the teachers preferred to use deep forest, rivers, ponds, and swamps more than the environment in city or public parks.

Marion Dresner and Mary Gill (1994) studied "Environmental Education at a Summer Nature Camp" to investigate students' knowledge, attitude,

and participation practice in the conservation of the environment while attending a summer nature camp. Dresner and Gill reported that the students attending the summer camp gained knowledge and understanding about ecology and that their behavior displayed partnership in activities. They gained more self- confidence, their human relationships had been changed, and their curiosity to know about the outside world also changed.

John S. Gambro and Harvey N. Switzky (1996) studied "A National Survey of High School Students' Environmental Knowledge" to investigate American high school students' basic knowledge on the environment. There were 2,900 students randomly selected from 103 schools who participated in the study. Gambro and Switzky reported that most of the students knew about environmental problems but they could not apply their knowledge. The researchers recommended that teaching and learning about EE should integrate current environmental problems into EE programs.

Sudjai Teppituksuk, La-or Cheevaprapai, and Priuj Kunsita (1997) organized a study on conservation of mangrove forests in order to introduce the students to recognize the value of mangrove forests and to participate in conservation and restoration of deteriorated mangrove forests behind Wat Asokaram in Samutprakarn province. The study included the following activities:

Activity 1. Survey the study area, and interview the people in the community to specify the species of plants to be planted, and time duration for planting.

Activity 2. Plantation Campaign by students and the people in the community behind Wat Asogaram in the area of 20 x 80 sq. meters. **Rhizophora apiculata**, a local plant with high resistance, was planted records were kept every week.

Activity 3. Study how the salinity of the water affected the growth of Rhizophora.

The study revealed that the students recognized the importance of mangroves and of co-operative work with the people in the community. The students' behavior towards the environment also changed.

Laddaval Kunhasuwan (1992) studied and developed a program to use the school ground area, which is the mangrove forest of Bangtaboon Vitaya, Banlam district, Phetchaburi province, as a learning and practice site outside of the classroom. Her organized program was composed of :

Step 1. Survey of the school ground area behind the building which was to be appropriated as a learning area and construction of learning stations divided into sea-shore coast, Sa-mae forest, Rhizophora forest, and Cha-cram field.

Step 2. Specify the learning area and learning stations. Construction of the bridge to connect each station was funded with support from UNESCO

Step 3. Develop the practical and training lessons affiliated with the learning stations.

Activity 1. Physical study of mangroves

Activity 2. Biological study of mangroves

Activity 3. Adaptation of plants and sea – shore animals

Activity 4. Relationships among organisms in mangrove forests

Activity 5. Advantage and important of mangrove forests

Kesara Pitayapanu (1995: Abstract) studied the relationships between knowledge of environment and behavior of ninth grade students in the Bangkok metropolitan area. She reported that although 52.20% of the students had a moderate level of knowledge regarding the environment, knowledge about ecology and environmental problems was at a lower level. Students expressed positive behavior towards protection of the environment, but expressed negative behavior regarding participation and partnership in solving environmental problems.

Waleerat Supanan (1997 : Abstract) developed a handbook for outdoor study on "Observation of Natural Resources and Environment" to encourage lower

secondary school students to gain knowledge and a better understanding of natural resources and the environment.

This review of previous studies reveals that very few studies and documents have been conducted regarding training curriculum on mangrove forests for secondary grade school students. It is the intention of the researcher to develop a training curriculum on mangrove forests for lower secondary grade school students and experiment with students at Saklasutira upatum School in Samutprakarn in order to restore mangrove forests and to develop a sense of awareness and partnership on the part of the students regarding conservation and protection of their environment.

CHAPTER III
RESEARCH METHODS

Method of Study

The purposed purpose of this study is to develop a training curriculum on mangrove forests for lower secondary grade school students and experiment with implementing the developed curriculum at Saklasutira upatum school and at Bangplee rajbumrung school in Samutprakarn province. The procedures are:

1. Documentary study in order to gain basic knowledge for the curriculum.
2. Curriculum development
3. Assessment of the developed curriculum
4. Experiment with the developed curriculum in the field
5. Evaluation of the developed curriculum

3.1 Documentary Study

1. The types of information required include:

1.1 Information on the thoughts, theories, and principles of development of training curriculum and training organization.

1.2 Information on the mangrove forest environment.

1.3 Information on the sites of training including the community and policies of involved units.

2. Sources of information, materials, and method of data collection.

The required information was collected through documentary study, textbooks, articles and reports and direct survey of the experimental sites.

3. Materials development and data collection.

3.1 The evaluation form for experts, educators, and teachers is based on David Pratt (1980 : 410-413), Tisana Keamani, (1981 : 4) and Sangad Utranund (1984

: 35) concerning: 1) rationale 2) objectives 3) contents 4) recommendations 5) guidelines and suggestions for training action 6) assessment of the developed curriculum. These were screened and assessed by an expert committee for content validity.

3.2 The Achievement Test for knowledge and understanding of the mangrove forest environment for lower secondary grade school students was composed of three parts :

Part 1. Test of the knowledge of the mangrove forest environment, it is a 30- item multiple choice test with 4 answer choices.

Part 2. Attitude test on the conservation of mangrove forests; it is a Likert's rating scale consisting of positive and negative choices on 10 items.

Part 3. Skills test on action and practices toward conservation of mangrove forests; it is a 19-item multiple choice test with 3 answer choices.

These tests were assessed by an expert committee for content validity. The tests were then administered to 40 students of the lower secondary grade at Bangplee rajbumrung School who were not in the experimental group. Analysis of the collected data defined the discrimination power and degree of difficulty to be 25% between the high and low groups (Boontham Kijpreedaborisuit, 1974 : 234)

The results are that the "P" value of the achievement test falls between 0.4-0.8. The "r" value falls between 0.4-0.7. The reliability value is 0.73 according to the Kuder Richardson Formular 21.

The Alpha coefficient by Cronbach of the attitude test is 0.75. The t-test value between the high and low groups falls between 2.82 – 6.36 at .01 level of significance.

The "P" value of the skills test falls between 0.45 – 0.80, and the "r" values falls between 0.40 – 0.60. The reliability value is 0.70 according to the Kuder Richardson Formular 21.

3.2 Curriculum Development

The process of curriculum development consisted of :

1. Define objective

2. Select the contents based on past experiences
3. Select the method of training and medias.
4. Define the method of assessment and evaluation
5. Document the developed curriculum

1. Define Objectives

According to the documentary study, the factors involved in training curriculum of the mangrove forests are: the process of the training program, the problems of conservation of mangrove forests, the policy of mangrove forest development, and EE organization. All of these factors together were considered to be the data base of this training curriculum development.

2. Select the contents based on past experiences.

To select the training program, the researcher reviewed these contents:

2.1 Basic knowledge of EE
2.2 Mangrove forest ecosystems
2.3 Advantage and value of mangrove forests
2.4 Problems, status and effects of mangrove forests
2.5 The ways to conserve and restore mangrove forests

3. Select the methods of training and medias.

Methods of training were selected from EE strategies, self study and direct action in the field, partnership activities, and outdoor education in accordance with learning theory. Two types of medias were applied; the first was actual activities at learning stations and the second was audio visual aids manipulation.

Construction of learning stations :

1. Survey the surrounding area of Saklasutira upatum school and community to select the site to set up the learning stations and provide a layout plan.

2. Plan to improve the school ground area for environmental study. The researcher and co-ordinator, set up the learning stations as follows:

2.1 Theory component: use of one vacant classroom on the second floor of building #1 as the center for EE of mangrove forest and for exhibition.

2.2 Practical component: use of the selected sites to construct:

2.2.1 Path walk along the muddy shore on the south part of the school for plant community and mangrove marine animals study.

2.2.2 Plants collection located at the back of building #3 for seedling marine plant collection.

2.2.3 Experiment station in the area around the water control gate and water way within the school to study the physical structure of mangrove forests.

2.2.4 Mangrove nursery located at the north site of the building for practical work on nursing mangroves

2.2.5 Mangrove station located at the back of building #1 for demonstration plot and growing new mangrove seedlings.

2.2.6 Bird watch station located at the corridor of the upper floor of building #2 for the bird watch station.

2.2.7 Field practice activities were conducted at the mangrove forest at Chulchomkloa Port in order to study the mangrove problems and practice restoration activities.

3. School ground improvement and community support to provide a path walk and learning stations was organized.

3.1 Center for mangrove forest information was organized as a lecture room for 60 students equipped with audio visual aids, video tape, slide projectors, posters, overhead projector, and pictures of mangrove forest conservation activities.

3.2 Path walk around the mangrove forest with directions for studying the plant community, *Nypa* palm, sa-mao *(Avicennia)* forest, and marine shore animal community.

3.3 Mangrove collective station with identification of each plant.

3.4 Experiment station equipped with appropriate instruments for soil, water, and weather study.

3.5 Mangrove nursery station equipped with necessary equipment for nursing new plants.

3.6 Mangrove station for new seedling study.

3.7 Bird watch station equipped with binoculars and mangrove bird field guide.

3.8 Field practice activities. The researcher requested the permission of official of Chulchomlkoa Port to use the port areas as a field study site and the conference room for discussion on mangrove forest problems. This are was also to be the site on which the trainees restored the forest by planting new plants.

The training program was approved by the school administrator and co-operative task force of school teachers, local government units and community members who supported the materials and funding.

4. Determine the method of evaluation for the training outcome.

There are two methods of evaluation:

4.1 The achievement of the trainees. Pre-test and Post-test were administered with tests on the knowledge of mangrove forest environment, attitude test on conservation of mangrove forests, and skills test on the action and practices toward conservation of mangrove forests, including a portfolio and follow up assessment.

4.2 The evaluation of the developed curriculum through questionnaires administered to the trainees and training personnel.

5. Documentary of the curriculum.

The developed curriculumwas composed of :

5.1 Rationale

5.2 Objectives

5.3 Contents

5.4 Recommendations

5.5 Guidelines and suggestions for training action

5.6 Assessment of the developed curriculum.

3.3 Assessment of the developed curriculum

1. Criteria to evaluate the developed curriculum

The developed curriculum was evaluated based on Pratt (1980) and Tisana Keamani (1981) principles and evaluated by a Likert's rating scale. The evaluation forms were assessed by an expert committee for control validity. The developed curriculum was composed of:

1.1 Rationale

1.2 Objectives

1.3 Contents

1.4 Recommendations

1.5 Guidelines and suggestions for training action

1.6 Assessment of the developed curriculum

2. Expert committee to evaluate the developed curriculum and give recommendations. There were five experts on the committee.

3. Educators and teachers seminar

EE educators and lower secondary school teachers were invited to participate in a seminar at Saklasutira Upatum School to express their thoughts and suggestions regarding the developed curriculum. The seminar was held on March 29, 1999.

4. Collect the evaluations and conduct a quality analysis

The evaluations from the five experts on the committee and from the educators and teachers were summed up and a quality analysis was conducted for each component by using the statistical mean to improve the curriculum before administering it to the trainees.

3.4 Implementation of the developed curriculum

1. Article to accompany the curriculum

Personnels' handbook, trainees' handbook, and the training plan to accompany the curriculum were also developed under the agreement of EE educators and teachers

2. Invitation to training personnel

Knowledgeable, experienced and qualified EE educators were invited to join in the training process. These personnel were experienced and had skills in transformation and training for large numbers of youngsters. (Kasem Chunkao, 1993 : 77) A small group meeting was held for these personnel to determine their role in the training procedure.

3. Training materials and media

Training materials and media were provided with the co-operation of training personnel and learning stations were prepared.

4. Training sites and buildings.

The training sites and buildings of the school were approved and supported by school administrators and staff.

5. The target of the training curriculum

The experimental groups of 30 students per school were chosen using stratified random sampling among the lower secondary school students of Saklasutira Upatum School and Bangpleerajbumrung school. A total of 60 lower secondary school students comprised the experimental group of this study.

6. Training procedure was composed of :

6.1 Registration

The selected students were required to register for the training program on June 17, 1999 at the conference room, Saklasutira Upatum School.

6.2 Training program opening ceremony

The opening ceremony for the training was held at 9.00 am on June 17, 1999 by the Director of Rajprachasamasai School. The audience was the trainees and training personnel.

6.3 The pre-test of the trainees was administered with the test on the knowledge of mangrove forest environment, attitude test on conservation of mangrove forest, and skills test on action and practices toward conservation of mangrove forests.

6.4 Training program in action

The training program was implemented as planned in the form of aworkshop with the following elements:

1) Theory component

The discussion accompanying the multi media presentation concerned basic knowledge of EE and mangrove forests, status, problems and effects of mangrove forests, views on conservation and mangrove forest restoration and encouragement of the knowledge, understanding and acknowledgement of the value of mangrove forests.

2) Practical component

Organization of the learning stations in the field was composed of:

1. Path walk along the muddy shore to study the plant community and sea shore animal community.

2. Mangrove collective station to study the diversity of sea shore plants in order to encourage conservation and restoration of mangrove forests.

3. Experiment station to study the physical structure of soil, water and temperature of mangrove forests.

4. Mangrove nursery station to demonstrate the training practices of nursing plants.

5. Mangrove station to study plants growth and problems in the restoration of the forest.

6. Bird watch station to study the relationship of birds within the mangrove forest ecosystem.

7. Field practice activities to study the mangrove forests in the community along the bank of river and the mouth of the river in order to encourage positive attitude and realization of mangrove forest problems and promote a will to participate in conservation and restoration of mangrove forests.

All trainees attended the theory session, after which they divided into small groups and circulated to study at all learning stations. Then all trainees participated in field trips and field practices.

6.5 The post-test was administered at the end of the training program.

6.6 The closing ceremony was held on June 18, 1999 at 16.30 pm in the reception hall of Chuljomkloaw Port chaired by the Prasamutjedee sheriff.

3.5 Training Curriculum evaluation

1. Criteria to assess the developed curriculum

The quality of the developed curriculum was based on the achievement of the curriculum implementation measured by:

1.1 The achievement test of the trainees on knowledge, attitude and skills revealed that the post-test scores were higher than the pre-test scores at .01 level of significance, and the average scores of the practical components was not less than 60% of the total.

1.2 Training personnel agreed that the implementation of the developed curriculum was above average.

2. Evaluation

2.1 Evaluation of the achievement of the curriculum implementation

1) Achievement test results of the trainees on knowledge, attitude and skills in conservation restoration and development of mangrove forests.

2) The difference between the pre-test and post-test was compared by t-test application at the .01 level of significance.

2.2 Evaluation of the implementation of the developed curriculum.

1) The curriculum was evaluated through a questionnaire administered to the trainers. This questionnaire used a Likert's rating scale with:

5 for most appropriate

4 for more appropriate

3 for moderate appropriateness

2 for less appropriate

1 for least appropriate

2) Evaluation of the curriculum, handbooks and training plan was conducted using a general questionnaire administered to training personnel.

3. Follow up

After the training programs were completed, the follow up was taken from the portfolio.

CHAPTER IV
RESULTS

This study on "Development of a Curriculum for Environmental Education on Mangrove Forests for Lower Secondary School Students in Samutprakarn Provice" is aimed at to developing a training curriculum on mangrove forests at Samutprakarn for lower secondary grade school students to encourage the is knowledge, understanding, and attitude, and to cultivate the sense of awareness and partnership in the conservation and restoration of mangrove forests. The results are presented in the following topics.

1. Results of basic information study.
2. Results of curriculum documentary construction.
3. Results of documentary study.
4. The test and experimental use of the curriculum.
5. Results of curriculum evaluation.

4.1 Results of basic information study.

1.1 Theories and principles in training curriculum are educational theories, knowledge, attitude, practices, theories in developing training curriculum, and training theories.

1.2 Mangrove information includes EE theory, definition, principles, aims and objectives, methods of EE teaching, meaning of mangrove, forests distribution, mangrove ecology, advantages and importantce of mangroves, status and problems of mangroves, conservation and development of mangroves.

1.3 Information was collected on the project area, community, and policies concerning the Samutprakarn mangrove forest, and of the office of policy and planning, Ministry of Science and Technology, Department of General Education Policy. Funding was supported through the local forestry department, Office of

Provincial General Education, Port of Chulchomkloa, and Saklasutira – upatum School.

4.2 Results of curriculum documentary construction.

EE TRAINING CURRICULUM ON MANGROVES

Principles and Rationales.

Mangrove forests have long been associated with the lives of Thai people since mangrove products have many advantages such as producing the best charcoal of its kinds, which can make hundreds of million of Baht each year as an export good. Its wood can be used to build houses and furniture. Mangrove forests are very important to marine fishery; they it provide shelter and food sources for small fish and newborn marine creatures. The foodchain and foodweb of the mangrove forests are valuable ecosystems and relate to the life of fishermen and their revenue. Unfortunately deterioration of mangroves is increasing even though the government canceled the concession on of all mangrove forests in 1996. Finally, the National Economic and Social Office declared that Thailand should have a mangrove forest area of not less than 1.05 million Rai by the end of 2001.

An effective way to solve the mangrove problems and sustain the restoration of mangrove forests is the cultivation of awareness and the sense of responsibility and partnership of the students in schools from lower secondary education on through the high school level. This concept coincides with the Office of Policy and Planning, Ministry of Science and Technology (1997) to urge youngsters and the public to know about and understand the environment.

In the past decade, the process of EE has failed to encourage the development of understanding and knowledge about the environment among students. Attitudes towards partnership in community problem-solving is negative and students' attitude toward conservation of natural resources is will (Kesara Pitayapanu : 1995)

Training every member of the public is very important. Training everybody break down barriers and builds relationships. This is the main strength of the

development of training curriculum on EE on mangrove forests for lower secondary grade school students and the experiment to implement the training curriculum with students at Saklasutira upatum School in Samutprakarn province. It is the belief of researcher that the training and partnership activities of the students to restore and reforest the mangrove forest will cultivate and develop the sense of awareness, responsibility, and partnership in solving natural problems and protect their environment with the cooperation of people in their community.

Objectives of the Curriculum

General Objectives

Training the students and public to know, understand, and to develop skills and a positive attitude toward participation in conservation and restoration of mangrove forests.

Specific Objectives

1. To educate the trainer with knowledge and understanding of the mangrove environment.
2. To cultivate the attitude of the trainer towards restoration of mangrove forests.
3. To develop skills and practices in conservation and restoration of mangrove forests.

Contents

Theory Component

One station was designated as the information center for mangrove forests ; it was composed of EE basic knowledge, mangrove ecosystem, advantages and value of

mangroves, status, problems and effects of mangroves and, ways to conserve mangroves.

Practical Component

Eight stations were constructed according to the physical structure of landscape.

2.1 Mangrove nursery station
2.2 Path walk station
2.3 Simulated ecosystem station
2.4 Bird watch station
2.5 Mangrove collective station
2.6 Experiment station
2.7 Mangrove forest station
2.8 Outdoor and field studies

Duration

The training curriculum is a short course of training over a two-days period with 4 hours allocated for the theoretical component and 12 hours allocated for the practical component.

Practical Plan of the Training Program

Information center for mangrove forest station behavioral objectives:

1. Be able to define the meaning and types of environment
2. Be able to explain the principle and objective of EE
3. Be able to define and specify the physical structure of the mangrove forest
4. Be able to identify elements of the mangrove ecosystem
5. Be able to explain foodchain and transformation of energy in the mangrove ecosystem

6. Be able to identify advantages and the importance of mangroves.
7. Be able to identify problems and effects of the mangrove forest.
8. Be able to explain status and problems of mangroves in Samutprakarn.
9. Be able to identify the guidelines to conserve mangrove forests.
10. Be able to classify the personal ability of individual members in the training group for conservation of mangroves.

Content

1. Basic knowledge of EE
   - 1.1 Meaning and types of environment
   - 1.2 Meaning and objectives of EE
   - 1.3 Principle of EE
2. Mangrove ecosystem
   - 2.1 Elements of mangroves.
   - 2.2 Elements of the mangrove ecosystem
   - 2.3 Functions and activities of the mangrove ecosystem
3. Advantages and value of mangroves
   - 3.1 Importance of mangroves
   - 3.2 Advantages of mangroves
4. Status of mangroves and its effects
   - 4.1 Problems and the causes of mangrove deterioration
   - 4.2 Status of mangroves in Samutprakarn and its effects
5. Ways to conserve mangroves
   - 5.1 Meaning of conservation
   - 5.2 Participation and partnership in mangrove conservation
   - 5.3 Management policy to conserve mangroves

Training Activities

1. Introduction to training program (Lecture from experts)
2. Group relationship activities and creation of small groups
3. Discussion and lecture on materials and medias.

Training medias

1. Training handbooks
2. Slides
3. Transparencies
4. Videotape

Evaluation

1. Pre-test of training
2. Participation and activities; participant observation

Time required : 3 hours

Practical Station 2

Mangrove Nursery Station

Behavioral Objectives :

1. Be able to prepare soil and bags for planting
2. Be able to conduct plantation of new plants

Content

1. Prepare new mangrove nursing plants and soil bags
2. Demonstration of the nursing of new mangrove plants

Training Activities

1. Preparing soil demonstration
2. Trainees practice on soil preparation
3. Demonstrate new plant plantation
4. Trainees practice planting new mangrove plants

Materials and medias

1. Worksheet
2. Content sheet
3. Nursing plants
4. Soil bags
5. Materials for nursing

Evaluation

1. Worksheet
2. Participant observation

Time required : 20 minutes

Practical Station 3

Path Walk Station

Behavioral Objectives :

1. Be able to identify characteristics and advantages of *Nypa palm*
2. Be able to identify characteristics and advantages of Sa-mea trees *(Avicennia)*
3. Be able to identify species and advantages of mangrove marine animals
4. Be able to identify species and disadvantages of weeds in the mangrove forest.

Content

1. *Nypa palm* forest
2. Sa-mea forest *(Avicennia)*
3. Top-tap forest *(Derris trifoliata)*
4. Mangrove marine animals

Training Activities

1. Trainees study mangrove plant communities
2. Trainees study mangrove marine animals
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Study points
3. Worksheet

Evaluation

1. Worksheet
2. Observation and discussion

Time required : 20 minutes

Practical Station 4

Simulated Ecosystem Station

Behavioral Objectives :

1. Be able to draw a foodchain of organisms
2. Be able to identity level of producer, consumer, and decomposer
3. Be able to identity characteristics of plant and animal adaptation.

Content

1. Relationships between living organisms and nonliving things
2. Balance of the ecosystem

Training Activities

1. Study from content sheet
2. Direct study from specified natural conditions
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Simulated ecological point
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required : 20 minutes

Practical Station 5
Bird Watch Station

Behavioral Objectives :

1. Be able to identify advantages of birds in the ecosystem
2. Be able to identify species of mangrove birds

Content

1. Birds in mangrove forests
2. Advantages of birds in the mangrove ecosystem training activities

Training Activities

1. Study from content sheet
2. Bird watch at specified location
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Study station
3. Binoculars
4. Articles and Bird watch handbooks

Evaluation

1. Worksheet
2. Participant observation

Time required : 20 minutes

Practical Station 6

Mangrove Collective Station

Behavioral Objectives :

1. Be able to identify no less than 5 mangrove plant species
2. Be able to identify the dominant characteristics
3. Be able to identify mangrove plant distribution

Content

1. Young mangrove plants in Samutprakarn
2. Mangrove plant propagation

Training Activities

1. Study from content sheets
2. Field observation at specified stations
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Specified learning station
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required : 20 minutes

Practical Station 7

Experiment Station

Behavioral Objectives :

1. Be able to check and observe physical properties of soil
2. Be able to check and observe physical properties of water
3. Be able to check and observe general conditions of climate

Content

Study physical structure of mangroves , soil, water and climate

Training Activities

1. Study from content sheet
2. Observe, check, and experiment
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Thermometer
3. Chemical substances to test soil and water
4. Lismuth paper
5. Test tubes

Evaluation

1. Worksheet
2. Results of the experiments

Time required : 20 minutes

Practical Station 8

Mangrove Station

Behavioral Objectives :

1. Be able to indentify root, stem, and leavf parts of Rhizophora
2. Be able to identify the animals which destroy Rhizophora in the experimental plot
3. Be able to explain how to care for mangroves

Content

1. Growth of Rhizophora
2. Characteristics of Rhizophora
3. Care and maintenance of mangrove forests

Training Activities

1. Study from content sheet
2. Study basic information from mangroves
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Learning station in the mangrove forest
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required : 20 minutes

Practical Station 9
Field Study

Behavioral Objectives :

1. Be able to identify mangrove species along the channel and in the community
2. Be able to identify occupations of the people in the community as they affect the mangrove forest.
3. Be able to explain effects of mangrove deterioration.

Content

1. Mangrove plant species along the channels and in the community
2. Activities of people in the mangrove community
3. Deteriorated areas along the sea-shore, mouth of the river and channels

Materials and medias

1. Content sheet / Worksheet
2. Specific sites of the channels, community and the mouth of rivers
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation during field studies
3. Discussion after field studies

Time required : 3 hours

Recommendations for the Implementation of Training Curriculum

1. Organization of training program should be clearly stated :
   - 1.1 Rationale and principles
   - 1.2 Training Objectives
   - 1.3 Content and training activities
   - 1.4 Training process and management
   - 1.5 Methods of evaluation
   - 1.6 Time requirement
   - 1.7 Time schedule
   - 1.8 Staff and trainers team
   - 1.9 Trainees
   - 1.10 Funding and budget
   - 1.11 Training facility needs
2. The site of training should be sea-coast or sea-shore where mangroves and tidal plants are growing naturally.
3. Training time should be on weekends or during school holidays
4. The training participants should be :
   - 4.1 Lower secondary school students
   - 4.2 Group of trainees should be no not larger than 60 students
   - 4.3 Careful pre-planning and advance communication with trainees
5. Trainers and experts should be carefully selected :
   - 5.1 Qualified and expert educators in EE with sufficient experience with mangroves as the focal issue of the training program
   - 5.2 Seven to nine qualified and expert educators should be available at all times during the training session
   - 5.3 Qualified and expert educators to join the training program should be notified in advance with enough time to allow for their preparation
6. Training fund and budget

The cost of the a day training program with 60 trainees, 9 qualified expert educators, and 5 personnel will be about 30,000 Bath.

Recommendation for the Training Process and Management

1. Training sites should be divided into separate areas ; one for discussion and academic display, and the other for field studies and practices.

2. During lecture and discussion sessions, all trainees should attend at the same time. During field studies and practical sessions, the trainees will be broken into small groups of 10 trainees who will rotate their activities according to the specific schedule at each learning station. Each group will spend 30 minutes at each station with the exception of field trips where all trainees will study as a group.

3. The discussion and lecture processes should coincide with the practical sessions:

3.1 Discussion and lecture should coincide with materials and medias

3.2 Discussion must include the opportunity for the trainees to express their thoughts and conflicts

3.3 Group processes are the main focus within the small group practical sessions.

3.4 After finishing field practices, each group must present their results to the whole group for evaluation

4. Materials and medias are significant, especially at the learning stations and during the field trips.

4.1 Materials and medias as required in each station must be carefully prepared to serve the practical component.

4.2 Materials and medias as required in theory, discussion, lecture, and demonstration must be available and ready to use at all times during the training session.

Evaluation of the curriculum

Three types of evaluation were employed:

1. Evaluation of trainees' achievement

Pre-test and post-test using the test of knowledge on mangrove forest; Attitude test on Conservation of Mangroves ; and Skills and Experiences on Conservation of Mangrove Test

2. Evaluation of Curriculum Implementation by using the expert educators questionnaire and the trainees questionnaire

3. Follow-up after training with a of portfolio check-up

4.3 Results of curriculum documentary check

Analysis of curriculum documentary from the 5 expert committees and teachers revealed that :

4.3.1 Average measure of Principles and Rationale of Curriculum is presented in Table 4.

Table 4 Evaluation of Principles and Rationale of Training Curriculum

Topics	Average $\bar{X}$	S.D.	Level of appropriateness
Development of Training Curriculum	3.6	0.55	High
Necessity of Curriculum	3.4	0.89	Moderate
Policy of each government unit	3.4	0.55	Moderate
Description of Policy	3.4	0.89	Moderate
Database to consider necessity of curriculum	3.0	0.70	Moderate
Principle and rationale of the whole curriculum	2.4	0.89	Moderate

Most topics are considered to be at the moderate level of appropriateness except the development of the curriculum which is at high level of appropriateness.

Table 5 Evaluation of Curriculum Objectives

Topics	Mean $\bar{X}$	S.D.	Level of appropriateness
General Objective			
Clarity and transparency	3.8	0.84	High
Flexibility of curriculum	3.8	0.45	High
Feasibility	3.6	0.55	High
Benefit to trainees	4.0	0.00	High
Coincidence with each unit policy	4.2	0.45	High
Specific Objectives			
Coincidence with general objectives	4.0	0.71	High
Coverage of specific objective	3.4	0.89	Moderate
Clearing of specified end behavior	3.6	1.14	High
Flexibility	4.6	0.45	High
Feasibility of practices	3.4	0.89	Moderate

The Curriculum objectives are mostly considered to at a high level of appropriateness.

Table 6 Evaluation of Content

Topics	Mean $\bar{X}$	S.D.	Level of appropriateness
Coincidence with curriculum	3.8	1.09	High
Coverage of the curriculum objectives	4.0	0.74	High
Appropriateness with the objectives	4.0	0.71	High
Interest of content	3.6	1.14	High
Appropriateness to the trainees	3.8	1.09	High
Value to the trainees	4.2	0.83	High
Time schedule appropriateness	3.0	1.22	Moderate
Clarity and transparency of the training	3.0	1.22	Moderate

The contents of the training curriculum are considered to be at a high level of appropriateness with the exception of time schedule and clarity of the training plan.

Table 7 Evaluation of Curriculum Implementation

Topics	Mean $\bar{X}$	S.D.	Level of appropriateness
Organization of training program	4.0	0.71	High
Appropriateness of the learning stations	4.0	0.71	High
Time duration of training program	3.8	0.45	High
Method of selecting the trainees	3.8	0.45	High
Method of selecting the expert educators for training	3.8	0.45	High
Funding and training budget	3.6	0.55	High

The implementation of the training curriculum is considered to be at a high level of appropriateness.

Table 8 Evaluation of Suggestions in the Training Program

Topics	Mean $\bar{X}$	S.D.	Level of appropriateness
Organization of the training sites	4.2	0.84	High
Steps and sequences of training	4.0	1.09	High
Processes and management of the training program	3.8	1.09	High
Materials and medias	3.8	1.09	High

The suggestions in the training program are considered to be at a high level of appropriateness.

Table 9 Evaluation of the training curriculum

Topics	Mean $\overline{X}$	S.D.	Level of appropriateness
Appropriateness of method of evaluation	3.8	0.45	High
Appropriateness of the tests used	3.6	0.89	High

The evaluation of the training curriculum is considered to be at a high level of appropriateness.

4.3.2 Suggestion for improvement of curriculum documentary

Table 10. Suggestions for improvement of the curriculum documentary show.

Topics	Suggestions
Principles and rationales	Information on mangroves should be increased to clearly display the changes that lead to the importance of the mangrove problems in order to encourage the knowledge, attitude and practices of the trainees
Curriculum objectives	The objectives should be stated in practicable terms; practical skills and knowledge should be clearly stated for each specific issue
Curriculum content	Decrease some repeat or overlap theories, emphasize more practical practices according to EE principles the for environment
Implementation of curriculum	The trainees should be distributed at all levels
Processes of training	Outdoor education and field studies should be stressed more
Curriculum evaluation	Measurement should stress specific conditions and the ways to solve the problems

4.3.3 Curriculum documentary evaluation from expert educators and 10 teachers

Table 11 Evaluation of Curriculum Implementation

Topics	Mean $\bar{X}$	S.D.	Level of appropriateness
Principles and rationales of curriculum	4.1	0.57	High
Specificity of the curriculum objectives	4.1	0.57	High
Curriculum content	3.8	1.05	High
Suggestions for curriculum implementation	3.8	0.82	High
Suggestions for training processes	4.2	0.78	High
Curriculum evaluation	3.8	0.91	High

The curriculum documentary is considered to be at a high level of appropriateness.

4.3.4 Suggestions to from expert educators and teachers improve the training curriculum

Table 12 Suggestions to Improve Training Curriculum

Topics	Suggestions
Principles and rationales	Add more clear mangrove information for the Samutprakarn site
Curriculum Objectives	Stress more practical behavioral objectives
Curriculum Content	Decrease repeat activities and add more time to the practice of each learning station in order to allow the trainees more time with mangroves
Curriculum Implementation	Daily activities should be scheduled
Training Processing	Add more time for practice : from 20 minutes to 30 minutes at each station
Curriculum Evaluation	The test and measurement should be improved

4.3.5 Results of Curriculum Improvement

According to suggestions from expert educators and teachers, the training curriculum should be improved on the following issues :

4.3.5.1 Principles and Rationales

Mangrove problems and Samutprakarn mangrove problems have been added along with EE principles to solve mangrove problems

4.3.5.2 Curriculum Objectives

Wordings in curriculum objective have been corrected according to the situation and practical behavioral objectives have been changed

4.3.5.3 Curriculum content

Theoretical contents have been adjusted in accordance with trainees' intellect and maturity. The time of practical sessions has been increased from 20 minutes to 30 minutes at each learning station

4.3.5.4 Curriculum Implementation

The time schedule of daily activities has been adjusted

4.3.5.5 Training Process

The practical time at each learning station has been increased to extend the outdoor activities and field studies.

4.3.5.6 Curriculum Evaluation

The testing of instruments to evaluate the outcome of the training program has been added

4.4 Results of the test of training curriculum

4.4.1 Supplementary article for use in the training curriculum

4.4.1.1 Supplementary articles have been distributed to provincial forest officers, fishery officers, general educators of Samutprakarn and expert personnel.

4.4.1.2 Supplementary articles include :

1) Handbook for expert educators which was composed of the training curriculum, discussion and lecture contents, practices and evaluation

2) Handbook for the trainers which was composed of training contents and activities, training plan, and practices

3) Other articles concerning the training program

4.4.2 Co-operative training program requests

Qualified teachers in secondary schools of Samutprakarn, EE personnel, Rajapat Pranakorn Institute's mangrove conservation officers, and Port of Chulchomkloa officers are requested to join the training program

4.4.3 Preparation and construction of training medias

Audio-visual medias have been prepared and organized for theoretical sessions in the information center.

4.4.4 Organization of the training sites

1) The training site is Saklasutira upatum School, Prasamut – Jedee Samutprakarn and the Port of Chulchomklao

2) Training date 17-18 June, 1999

3) Trainees are lower secondary education students randomly selected from Bangplee-rajbumrung and Saklasutira-upatum School, 30 students from each school for a total of 60 students.

4.4.5 Results of the training program

4.4.5.1 Registration was made on June 17, 1999 at 8.00 am., 60 trainees registered

4.4.5.2 The opening ceremony of the training program was held by the Director of Rajpracha-samasai School. The audience was expert educators, the trainees, representatives from the from local forestry, and fishery, general education office, provincial supervisor, and secondary school principals in Prasamutjadee district, Samutprakarn

4.4.5.3 The trainees took a pre-test evaluation

4.4.5.4 Training processes

1) Expert educators and EE personnel fulfilled their duties as planned by emphasizing the on participation and partnership of the trainees.

2) The trainees were interested in the activities and exhibited good participation and partnership

4.4.5.5 After finishing training program, the trainees took a post-test evaluation

4.4.5.6 The closing ceremony was held on June 18, 1999 at 4.30 p.m. by the sheriff of Prasamut-jadee district.

4.5 Analysis of the training curriculum evaluation

4.5.1 Curriculum achievement

Comparison of the pre-test and post-test of the two groups of trainees (Bangplee rajbumrung School VS. Saklasutira-upatum School) is presented in Table 13

Table 13 Comparison of knowledge, attitude and EE skills of the two groups of trainees

Bangplee rajbumrung group (Outside area)						
Test of	**n**	**Pre-Test**		**Post-Test**		**t**
		$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**	
Knowledge	30	16.80	4.47	20.37	4.21	5.02**
Attitude	30	41.87	4.55	44.17	3.77	4.89**
Practical skills	30	11.37	2.55	13.30	2.10	3.46**

Saklasutira upatum group (Inside area)						
Test of	**N**	**Pre-Test**		**Post-Test**		**t**
		$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**	
Knowledge	30	16.47	3.34	19.90	3.18	5.89**
Attitude	30	42.40	4.67	44.80	4.01	4.64**
Practical skills	30	12.10	2.16	14.17	1.62	6.29**

** $P < .01$ ($t_{29} = 2.76$)

The knowledge, attitude and practical skills of the two groups was significantly different between the pre-test and post-test (at a .01 level of significance)

Table 14 Comparison between the two groups of trainees

Group	n	Pre – Test		Post - Test	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
Outside area (Bangplee)	30	16.80	4.47	20.37	4.21
Inside area (Saklasutira)	30	16.47	3.34	19.90	3.17
F		3.813		4.008	
t		.327 NS		.485 NS	

Ns P > .05

The two groups are not significantly different.

Table 15 Attitude of the trainees toward conservation of mangroves

Group	n	Pre – Test		Post – Test	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
Outside area	30	41.87	4.55	44.17	3.71
Inside area	30	42.40	4.67	44.80	4.01
F		0.000		0.533	
t		-1.407 NS		-0.630 NS	

NS P > .05

The attitude of the two groups toward conservation of mangroves is not significantly different

Table 16 Practical skills of the trainees on conservation of mangroves .

Group	n	Pre – Test		Post - Test	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
Outside area	30	11.37	2.55	13.30	2.10
Inside area	30	12.10	2.16	14.17	1.62
F		0.982		2.274	
t		-1.202 NS		-1.788 NS	

NS P > .05

The practical skills of the two groups on conservation of mangroves are not significantly different.

4.5.2 Curriculum Implementation Evaluation

Table 17 Opinion of the trainees towards the training program

Topic evaluation	$\overline{X}$	S.D.	Level of appropriateness
1. Appropriateness of theory component.	3.97	0.84	High
2. Appropriateness of practical content	4.12	0.80	High
3. Appropriateness of training processes	4.23	0.69	High
4. Time sequence for theory component	3.60	0.84	High
5. Time sequence for training component	3.68	0.85	High
6. Appropriateness of expert educators	4.20	0.73	High
7. Appropriateness of the site for the theory component	3.72	0.78	High
8. Appropriateness of the site for the training component	4.27	0.63	High
9. Appropriateness of materials and medias	3.88	0.80	High
10. Appropriateness of supplementary articles	4.18	0.75	High
11. Appropriateness of training facilities	3.80	0.82	High
12. Appropriateness of mangrove knowledge	4.27	0.70	High
13. Appropriateness of field studies	4.21	0.71	High
14. Appropriateness of time duration	3.48	1.02	Moderate
15. Appropriateness of food and drink service	4.03	0.86	High

The trainees expressed their opinions toward the training program to be at a level of high appropriateness except for the time duration which was at moderate level. The trainees suggested increasing the training time to 3-4 days duration.

4.5.2.2 Opinions of the expert educators and EE personnel

Table 18 Opinions of the educators and EE personnel

Topic evaluation	$\bar{X}$	S.D.	Level of appropriateness
1. Appropriateness of curriculum objective	4.22	0.67	High
2. Appropriateness of curriculum objective and content	4.11	0.33	High
3. Appropriateness of theoretical content	3.78	0.67	High
4. Appropriateness of practical content	4.11	0.60	High
5. Appropriateness of training processes	4.22	0.67	High
6. Appropriateness of time for the theory component	3.56	0.53	High
7. Appropriateness of time for the practical component	3.67	0.50	High
8. Appropriateness of field studies	4.00	0.70	High
9. Appropriateness of training climate	4.00	0.70	High
10. Appropriateness of lecture and discussion room	4.00	0.70	High
11. Appropriateness of learning sites	4.00	0.70	High
12. Appropriateness of materials and medias	3.78	0.67	High
13. Appropriateness of supplementary articles (handbooks)	4.00	0.70	High
14. Appropriateness of expert educators	4.44	0.53	High
15. Appropriateness of evaluation methods	4.00	0.70	High

The expert educators and EE personnel considered all the training activities to be at a high level appropriateness. The suggested increasing the time for the practical components at each station, and recommended that the trainees would benefit form staying overnight in the field.

4.5.2.3 The follow up

There months after the training program ended, the follow up study was conducted.

Table 19 Follow up of restoration of mangroves of the outside area group (1st group)

Activity	Process	Outcome
1. Planning 1.1 Plan meeting to specify activities 1.2 Assign jobs and responsibilities	1. Project approval 2. Request permission from teachers to use meeting hall 3. Invite members to meeting	1. 30 members attended the meeting 2. Assigned responsibilities 2.1 Mangrove knowledge articles: Rhizophora group 2.2 Exhibition : Sa-mae group 2.3 Line-broadcasting: Sa-mae crab group 2.4 Spot poster : Sea-gull group 2.5 Mangrove plantation : Bi-pedal fish group (Lung fish)
2. Operation 1. Distribution of articles 2. Exhibition 3. Line-broadcasting 4. Spot poster 5. Mangrove plantation	1. Co-ordinate with school communication channels and advise teachers: 1.1 Prepare articles for public 1.2 Request to use school broads 1.3 Request to use Line-Broadcasting	1. Article to report status and problems of mangroves 2. Exhibit the mangrove plantation activities 3. Line-broadcasting on knowledge of mangroves on accessions 4. Spot poster on mangrove conservation

Table 19 Follow up of restoration of mangroves of the outside area group (1st group) (cont.)

Activity	Process	Outcome
	during noon-school break 2. Co-ordinate with government units 2.1 Request nursery mangrove plants from local forestry 2.2 Request Port of chulchomkloa to plant Rhzophora	5. Plant 500 Rhizophora trees in a 2 Rai area. Public participation of 76 persons
3. Evaluation and conclusion	1. Observation on of activities, participation and partnership 2. Documents and work products	1. Interesting and curiosity to participate in activities of the public 2. The participants respond to share the cost 3. The participated people who gained skills and experiences in mangrove plantation

Table 20 Follow up of restoration of mangroves of the inside area group (2st group)

Activity	Process	Outcome
1. Planning 1.1 Plan meeting to specify activities 1.2 Assign jobs and responsibilities	1. Project approval 2. Request permission from teachers to use meeting hall 3. Invite members to meeting	1. 30 members attended the meeting 2. Assigned responsibilities 2.1 Mangrove knowledge article : Rattiya and others 2.2 Line-broacasting : Nutt and others 2.3 Prepare nusing plants : Pongdanai and others 2.4 Mangrove plantation : Amnaj and others
2. Operation 2.1 Information plates 2.2 Line-broadcasting 2.3 Nursing Rhizophora 2.4 Rhizophora plantation	1. Request to use school boards 2. Exhibit spot poster on species of plants and forests animals in mangrove 3. Line-broadcasting 4. Nursing Rhizophora in nursery 5. Plant Rhizophora along the Soksawas-Sakla road-side	1. Exhibit sport poster 2 times 2. Line-broadcasing each week for one month (August) 3. Nursing 100 Rhizophora 4. Plant 100 Rhizophora to protect the bank form erosion ; 50 persons participated in the activities.
3. Evaluation and conclusion	1. Observation of activities and participation 2. Documents and work products	1. Many members of public participated in the program 2. Participants gained skills and experiences in mangrove plantation

The results from Table 16 and 17 reveal that the training program according to the training curriculum on mangroves has been achieved and has been able to cultivate the partnership of the students and public in order to realize the value of mangroves and conservation of mangroves as such.

CHAPTER V
DISCUSSION

5.1 Procedures in Curriculum Development

The principles of curriculum development by Tyler (Oliva, 1992, p.169) and Sangad Utranund (1984, 35) along with other principles of education are used as the main theme of this curriculum development. There are five steps in the curriculum development: namely, documentary study for basic knowledge of curriculum, curriculum development, assessment of developed curriculum, experiment to implement the developed curriculum in the field, and evaluation. This study revealed that the developed curriculum worked well in the practical field. The trainees made progress in development of knowledge, attitude, skills and experiences in conservation of mangroves. It is important to note that the five steps in curriculum development served to make this task successful.

5.2 Experimental Results:

The post-test scores of the trainees on the achievement test are higher than the pre-test scores by 60 percent (a significant difference at .01 level). Three months after the training period, the follow-up work products are apparent to all, even though this was a short course training curriculum over a two- day period. This success is based on its objectives, contents, method of training and materials, practical activities, personnel educators, and method of evaluation. Following are some points to discuss in detail:

5.2.1 Objectives : The objectives of training curriculum were created from analysis of the data base of the community and the existing problems of each government unit which coincided with Sumon Amornwiwat and Sompong Jitradab (1988 : 110 – 111) and Tongsri Kampu Na Ayuthaya's (1995 : 5-8) works, which

concluded that curriculum objectives should be based on the existing problems and needs of the community.

5.2.2 Method of training

The significance of the curriculum development is the practical implementation in the field and its outcome which leads to the attainment of the goals and objectives. These involved well organized planning activities. This training curriculum was developed on the basis of the psychological and learning theory of the 1999 National Education Act and Environmental Education Program of UNEP (1992), which emphasizes co-operation and partnership between the public and schools. The role of personnel educators and practical works in the field has been carefully and clearly delineated. Group work and the group process are stressed. This coincides with the work of Ricard Floyd Derrah (1995) and John S. Grambro, Harvey N. Switzky (1996) who stated that problem solving and participation are the heart of environmental education.

5.2.3 Training Activities

The training activities were created around the basic needs of the trainees and opened up opportunities for co-operation and participation or partnership among trainees and personnel educators with actual experiences in the field. Its success coincides with Gilbertson (1990), Marion Dresner & Mary Gill (1994), Bentley (1982 : 2900A-2910A) and Vinai Veeravatnanond (1987) works which stressed outdoor activities which can change the attitudes and learning behavior of the students.

5.2.4 Personnel Educators

Personnel education is the key to success of the training processes and training activities. Educators should be keen experts in their field and should deeply understand the contexts of Environmental Education. They should function according

to their job and life experiences, which coincides with Kasem Chunkao's (1993 : 152) recommendation.

5.2.5 Training Materials and Environmental Climate

The success of the program can be attributed to the provision of training materials and medias both in special rooms for theories and academic issues of ecological knowledge and EE through slides, video tape, transparencies, worksheets, content sheets, and outdoor activities, such as path walks and learning in experimental stations in the actual environmental climate, including actual practice on mangrove plantation at the Port of Chuljchomkloa and the bird watcher station which brought out the pleasure and satisfaction of the trainees. The success of this program coincides with the works of Falk and Balling (1984 : 22-28), Gilberson (1990) Waleerat Supanan (1997) Laddaval Kanhasuwan and others (1997 : 11-12).

5.2.6 Evaluation

Another factor that made this training curriculum successful is the method of evaluation. The developed training curriculum was evaluated by the expert committee before implementing it with experimental groups. Assessment was again conducted to evaluate its validity and confidence level. After evaluation, the curriculum was then implemented with the action group and reevaluated once more after the training process had ended. Evaluation reveals that the training activities and methods of organization and operation brought about changes in attitude and behavior of the students concerning conservation of mangroves and restoration of mangrove forest in their homes. This coincides with the works of Vichai Vongyai (1986 : 34-40), Sangad Utranund (1984 : 227), Sumon Amornwiwat, and Sompong Jitradab (1986 : 319) on the retention of the subject taught to the students if the training curriculum has been well drawn up and prepared.

CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion :

1) Five steps in developing training curriculum

1.1) Documentary study for basic knowledge and curriculum theories; data-base on mangrove environmental education, physical feature of the study area, community, and government unit policy.

1.2) Curriculum development

The training curriculum is a short course of training on conservation and restoration of mangrove forest for lower secondary school students which aimed at to build up basic knowledge of environment, ecology, and environmental education leading to the creation of their awareness, attitude, and behavior in cooperation and partnership with the public to solve existing problems of the mangrove forests.

The training curriculum was created around the local problems, community, the child- centered principle, outdoor activities, actual practices in the mangrove plantation field, bird watching and ecological features around their school and community. There are two components of the training curriculum: theoretical issues on ecology and environmental education and practical experience in learning stations outside the classroom and school. This last component included field study and practical learning in the real field of the mangrove plantation.

The evaluation of the training curriculum was divided into three parts: evaluation of the achievement of the trainees, evaluation of the curriculum implementation, and follow up two months after the training program had ended.

1.3) Assessment of the developed curriculum

The training curriculum has been assessed by five experts before and after implementation. There are some suggestions for adjustment; for example, more emphasis should be given to mangrove problems, objectives should be stated in

behavioral terms, the content should replace some theory with practical activities, and practical time at each learning station should be increased.

1.4) Experiment to implement the training curriculum

The improved training curriculum has been implemented with two groups of lower secondary education students with thirty students in each group; one group of students was randomly selected from a school located outside the project area, and the other group was also randomly selected from Saklasutera Upatum. The implementation operated on June 17-19 1999 at the mangrove area of Saklasutera Upatum School and at the Port of Chulchomklao plantation.

1.5) Evaluation

Pre-tests and post-tests were administered throughout the training program. There are tests on environmental education and mangroves, attitude toward conservation of mangroves, the test on skills and experiences in the mangrove forests, and the questionnaire to assess the opinion of personnel educators and trainees.

2) Provision of study areas and field study

The mangrove areas of Saklasutera Upatum School were selected as the sites for the creation of 6 learning stations for activities and field study at the Port of Chulchomklao mangrove plantation. The six learning stations and field studies are:

2.1) Path walk along the muddy shore on the south part of school for plant community and mangrove marine animal studies.

2.2) Plant collection station at the back of building #3 for seedling marine plants collection.

2.3) Experimental station in the area around the water control gate and the water way within the school to study the physical structure of mangrove forests.

2.4) Mangrove nursery station at the north side of the building for practical work on nursing new plants.

2.5) *Rhizophora* station at the back of building #1 for a demonstration plot and growth of new mangrove seedlings.

2.6) Bird watch station at the corridor of the upper floor of building #2.

2.7) Field studies and activities utilized the mangrove forest at the Port of Chulchomklao in order to study the mangrove problems and mangrove restoration.

3) Result of the Training Curriculum

3.1) Training curriculum was composed of:

3.1.1) Rationales

3.1.2) Objectives

3.1.3) Contents

3.1.4) Recommendations

3.1.5) Guideline and suggestions on training action

3.1.6) Assessment of the developed training curriculum

3.2) Assessment of the training curriculum

3.2.1) Criteria to evaluate the developed curriculum was based on Pratt (1980) and Tisana Keamanee (1981) principles and evaluated by a Likert's rating scale. The evaluation forms were assessed by an expert committee for content validity and recommendations.

3.2.2) The evaluation from committee of five experts and from educators were summed up and analyzed for quality of each component according to the statistical mean in order to improve and adjust the curriculum before implementing it.

3.3) Implementation of training curriculum results

The post-test scores of the students on the achievement test are higher than the pre-test scores by 60 percent which is a significant difference at the .01 level. There are no significant differences at the .05 level on knowledge, attitude, skill and experiences of the two group both before and after training. The training activities and methods of organization and operation brought about changes in the attitude and behavior of students toward conservation of mangroves and restoration of mangrove forests in their home and community. The author, therefore, is confident that this training curriculum can be used and implemented in schools around mangrove forest areas or may be used in schools outside the mangrove forest areas if appropriately adjusted to the nature of these areas.

6.2 Recommendations:

6.2.1 Recommendations from the research

After implementation of the training curriculum on mangroves at Samutprakarn province, the author would recommend that:

1. Training curriculum should organize the contents and activities in accordance with the nature of the school area or the study areas.
2. The training session should operate on the week-end or during school holidays so that the activities can be conducted in a full-time capacity.
3. The training curriculum and activities are appropriate for lower secondary school students, and the number of students should not exceed 60 students per session.
4. Personnel educators and team members should be carefully selected and should be qualified with experiences in environmental education and learning theories. They should be hard working and enjoy working with students at this age and level. Provision of materials, medias, and facilities should be well equipped and prepared for use at all times.
5. Information and data-bases from government units are not sufficient; the actual information from the community is required.

6.2.2 Recommendation on Policy :

Due to the economic and social importance of mangroves to the Kingdom, it is a necessity to develop conscientiousness and understanding of the conservation and sustainable management of the environment. Therefore the extension of this training curriculum is significant to the Ministry of Education, Religion, and Culture in order to implement it to train teachers, or school administrators to promote the training curriculum among co-ordinating institutes, school groups, or educational regions responsible for education of local students. Such training should be planned according to educational policy in order to train students about mangrove forests every year.

In secondary education, each school should implement policy to allow teachers and students to organize their own activities together in term of extra curricular group circles for conservation and development of mangroves along with outdoor education and field practices in mangrove areas.

6.2.3 Recommendations for further study

1. To develop training curriculum on mangroves with students who live outside the mangrove areas.
2. To develop training curriculum on mangroves for higher secondary school students.
3. To create models for the study of mangrove forests which will be appropriate to each region of Thailand.

BIBLIOGRAPHY

Amorn Raksasat and Soraj Sujaritkul. (1981). Personnel Administration in Thailand. Bangkok : Thamasart University Press.

Arjampol Kumpanond. (1998). Briefed Guideline and Experiences on Management of Environmental protection Project. Arts and Environmental Conservation Society, Bangkok : Nai Wit Publishing.

ASEP Newsletter. (1996). Environment through the eyes of children. (March 1996). 12 (1) 6, 13.

Banjong Pongsart. (1994). Direction/Policy on Environmental Education and Management of General Education Department, Ministry of Education. Mimeograph.

Beach, Dale S. (1970). Personnel : The Management of People at Work. 3 rd ed., New York : Macmillan Co.

Beauchamp, G.A. (1981). Curriculum Theory. 4th ed., Itasca, Illionis : F.E. Peacock Publisher.

Bentley, M.L. (1986). The Role of Backcountry Experience in Middle School Environmental Education Dissertation Abstracts International. 46(10). 2900A-2901A.

Bloom, B.S., et al. (1956). Taxonomy of Educational Objectives Textbook I : Cognitive Domain. New York : David McKay.

Boonchana Klankamsorn and Thongchai Jaruppat. (1987). Reports on Classification of Land Use of Mangrove forest in Thailand. Bangkok : Landsite Image Section, Forest Management Division, Thai Royal Forestry department.

Boontham Kitpreedaborisuit. (1984). Methods of Research in Social Science. Fourth edition. Bangkok : Pranakorn Publisher.

_____. (1988) Construction of Instrument to Collect Data for Research. Bangkok : Srianand Publisher.

_____. (1988) Methods of Research in Social Science. Fifth Edition. Bangkok : Samchareanpanich.

Bruner, J.S., Oliver, S.R., Greenfield, P. (1966). Studies in Cognitive Growth. New York : McGraw Hill.

Chompan Kunchorn Na. Ayuthaya (1987) Article on Curriculum Development. Bangkok : Srinakarinwirot University, Prasanmits.

Department of Curriculum and Instruction Development, Ministry of Education. (1979) Guideline to use Lower Secondary school Curriculum Year 1978. Bangkok. Amarin Printing Co.

_____. (1993) Report on Quality of Educational Evaluation in Lower secondary School for The Year 1993. Bangkok. Kurusapa Publishing Ladproaw.

Department of Environmental Promotion. (1993) Mangrove Forest. Bangkok. Co-Operative Agriculture of Thailand Ltd.

Department of Environmental Quality Promotion. (1996). Summary Master Plan and Action Plan Environmental Education at National Level B.E. 2540-2544. Ministry of Science, Technology and Environment, Thailand.

Department of Forestry. (NA). A Cabinet Minister Resolution on Mangrove Forest. Bangkok (Mimeograph)

Department of Land Development. (1990) The Land Used Plan of Samutprakarn Province 1990. Bangkok. Land Use Planning Division.

Derrah, R.F. (1995). The status of Environmental Education in the secondary school of the State of Maine. Doctoral dissertation, Walden University.

Development of Environmental Education Circle (NA) Supplementary Document on Developmental Administration of Environmental Education. 48.5

Dresner, M. & Gill, M. (1994). Environmental Education at Summer Nature Camp. The Journal of environment Education. 25(3), 35-41.

Eag-Vit Na Talang. (1998) "Youth is the real source to solve environmental problems" TEI Membership Note. Thai Environmental Institute.

Falk, H.J. & Balling, J.D. (1982). The Field Trip Millicee : Learning and Behavior as a Function of Contextual Events. The Journal of Education Research. 76, 22-29.

Fien, J. & Tilbury, D. (1996). Learning for a Sustainable Environment : An Agenda for Teacher Education in Asia and the Pacific. UNESCO Principal Region office for Asia and the Pacific, Bangkok.

Flippo, Edwin, B. (1996). "Implications for Training". In Training and Development Handbook. P. 40 Edited by Robert L. Craig. New York : Mc Graw-Hill, Inc.

Fonselius, Stig H. (1972). "Stagnant Sea" In Meadows, D. and other. The Limit to Growth. New York : Potomac Association Book.

Folley, John D. (1967). "Implication for Training". In Training and Development Handbook. P.40 Edited by Robert L. Craig. New York : Mc Graw-Hill, Inc.,

Gambro, J.S. & Switzky H.N. (1996). A National Survey of High School Students' Environmental Knowledge. The Journal of Environmental Education. 27(3). 28-33.

Good, Cater Victor. (1973). Dictionary of Education. New York : Mc Graw Hill.

Hilgard, E.R. (1962). Introduction to Psychology. New York : Harcourt, Brace and World Inc.,

Information of School in Samutprakarn (1997). Saklasutira Upatum School. Prasamut Jedee District.

Jintana Unipan (1984) Learning and Teaching Registered Nurses. Bangkok Chulalongkorn University.

Jones, R.G.B. (1974). Guidelines for Instructional Technique. Bangkok Thailand : Department of Public Welfare.

Joseph N.B. (1975). "An Analysis of Literature to develop the Environmental Health Content for School Curriculum". Dissertation Abstract International. (February)

Kunawut Ranchan. (1989) Construction and Evaluation of Training Curriculum on Conservation of Natural Resource and Environment for Young Farmers out of School in Rural Northeastern. Master degree thesis in Technological Environment Administration, Graduate School, Mahidol University.

Kasem Chunkao. (1993) Environmental Education. Bangkok. Aksornsiam Publisher.

Kastenholz, H.G. & Erdmann, K.H. (1994). Education for responsibility within the framework of UNESCO. Journal of Environmental Education. 25(1).

Keating M. (1993). Agenda for change. The Earth Summit Geneva : SRO-kunding S.A.

Kesara Pitayapanu (1995) Relationship Between Environmental Knowledge and Environmental Behavior of Ninth Grade Students. Bangkok.

Kobkij Tuncharernrat (1993). Development of Training Personnel Curriculum for Health of Elderly People. Doctoral Thesis, Graduate School, Srinakariwirot University, Prasanmit.

Krich Ampoch (1997) Construction of Curriculum and Training Project. Bangkok. NIDA.

Laddaval Kanhasuwan. (1991). Environmental Problem Solving with Education. Research Article for Development Vol.15 pp. 111-116.

_____. (1992). Organize Environmental Education. Environmental Education Center. Pranakorn Rajapat Institute. (Mimeograph)

Lozzi, L. (1990). Assessment of Learning outcomes in Environmental Education. Paris, France : UNESCO.

Mahidol University, Faculty of Environment and Resources. (1992). Youth and Conservation of Environment. (Mimeographs)

Malinee Jutarop. (1994). Psychology of Learning and Teaching. Bangkok : Tipborisut Publisher.

Meadows, D. (1972). "Stagnant Sea" In Meadows, D. And other. The Limit to Growth. New York : Potomac Association Book.

Ministry of Education (1991). Master Plan on Environmental Education Project Year 1991-1996. Mimeograph.

Ministry of Foreign Affairs (1994). The 21st Plan for Sustainable Development. Bangkok.

Noi Sirichote (1981) Training Techniques.. Bangkok : Odeon Store.

Office Of General Education, Samutprakarn Province. (1997). Development of Center for Mangrove Environmental Education Project. Samutprakarn province. Mimeograph.

Office of Policy and Environmental Planning. (1997) National Policy and Planning to Promote Environmental Quality. Year 1997 – 2001. Bangkok : Integrated Promotion Technology Co., ltd.

Office of the National Economic and Social Development Board. (1996). National Economic and Social development Planning Eighth Edition (1997 – 2001). (Duplicated Copy). Bangkok : Office of the Prime Minister.

Office of the National Environment Board. (1983) Policy and Measurement of National Environment Development. Bangkok : The Secretariat of the Cabinat Printing House.

Paphavasit, N. (1995). Factors Maintaining Biodiversity of Mangrove Forest in Thailand. In C. Khemnark, S. Aksornkoae, V. Jintana, U.chaochalakorn & R.W. Jones (Eds). Ecology and Management of Mangrove Restoration and Regeneration in East and Southeast ASIA. (pp.80-96). Proceedings of the ECOTONE IV (18-22 January 1995) wang Tai Hotel, Surat Thani, Thailand.

Piaget, J. (1972). Intellectual evaluation from adolescence to adulthood. Human Development.

Piyaporn Siplavong & Narin Jetanasamritchok. (1997). Mangrove Maintenance project. National Seminar on Mangrove 10th (20-25 August 1997) Songkla : J.B. Hotel Hadyi.

Pranakorn Teacher College. (1998). Workshop Project on Organization of Environmental Education Activities in Secondary Schools. Bangkok : Department of Teacher Education. (Mineograph)

Pranee Ramsodt. (1985). Adolescent Psychology. Bangkok : Rungwatana Publisher.

Prapapen Suwan. (1997). Attitude : The Measurent of Change and Behavioral Health. Bangkok : Thaiwatanapanich.

Prathampidok. (1996). Sustainable Development. Bangkok : Sahathamig Co.

Pratt, David. (1980). Curriculum : Design and Development. New York : Harcourt Brace Jovanovich.

Pornpimol Jeam-nakarin Development of Adolescence. Bangkok : Ton-aue grammy co., Ltd.

Pinyo Sathorn. (1964). Personnel Management. Bangkok. Thailand panich Ltd.

_____. (1961). Principle of Administration. Bangkok : Watanapanich.

Preung Kumut. (1997) Training Techniques. Bangkok : Srinakarinwirot University, Prasanmitr.

Sakorn Puttapuan. (1991). Development of Training Curriculum on Prevention of Wrong use of Medicine and Habit-forming Drugs for Fundamental Health Personnel. Doctoral Thesis. Graduate School, Srinakarinwirot University, Prasanmitr.

Sawadi Sukontarungsee. (1982). Theory and Principle of Research. Bangkok : Reunkeaw Publishing.

Schmieder, A. (1997) "The nature and philosophy of Environmental Education : Goals and Objective". Trends in Environmental Education. Paris : UNESCO.

Schwarb Karl. (1983). Instruction Method : Their use and Effectiveness in Environmental Education. Vol.14 p.2 n.p.

Science Section. (NA). Mangrove. Samutprakarn : Saklasutera-upatum School, Prasamut Jedee District.

Simmons, D. (1998). Using Natural Settings for Environmental Education : Perceived Benefits and Barriers. The Journal of environmental Education. 29 (3) 23-31.

Sa-ngad Utranund. (1984). Fundamentals and Principles of Curriculum Development. Bangkok : Vongdeun Publisher.

_____. (1985). Fundamentals and Principles of Curriculum Development. Bangkok : Center Publication.

_____. (1989). Fundamentals and Principles of Curriculum Development. Bangkok : Mitsiam.

Sanit Aksornkoae. Sonchai Havanond, Chatri Maknual. (1996). Handbook for Mangrove Plantation. Bangkok : Funny Publishing Co.

Sanit Aksornkoae. (1989). Mangrove, Ecology, and Management. Bangkok : Compute Advertising Part.

Somchai Sreemongkoltip. (1997). Mangrove : Lesson from the Past toward Conservation. Bangkok : Center for Training Community forestry of Asia and Pacific region.

Somkid Thanareungsakulthai. (1990). Development of Training Curriculum for In-service Teachers on Industrial Arts Techiques to Promote Teaching Competency. Doctoral Thesis, Graduate School, Chulalongkorn University.

Sompong Kasemsin. (1968). Types of Training. Thailand wholesale Co-opertive Prinnting.

So-pida Patanaporn. (1997). Construction and Experiment on Training Curriculum of Environmental Education on Conservation of Seashore Resources for Lower Secondary Education Teachers : A Case Study of Ra-yong Province. Master degree thesis in Environmental Education. Graduate School, Mahidol University.

Sroythong Sirimongkol. (1988). Construction of Training Curriculum on Environmental Education of Lower Secondary School Teachers : A Case Study in Samutprakan Province. Master degree Thesis in Environmental Education. Graduate School, Mahidol University.

Stapp, William. B. (1979). "Preservice Teacher Education". Trends in Environmental Education. Belgium.

Sucha Janem. (1997). Psychology of Development. Bangkok : Thaivatanapanich.

Suchart Leetrakul. (1989). Development of Curriculum for Construction Laborers' Children in Bangkok Area. Doctoral Thesis, Graduate School, Srinakarinwirot University, Prasanmitr.

Suchart Somprayoon. (1997). Curriculum and Teaching. Bangkok : Thai Wattana Panich.

Sudjai Teppituksuk, La-or Cheevaprapai, and Pirut Kunsit. (1997). Mangrove Maintenance Project. National Seminar on Mangrove 10th (20-25 August 1997) at J.B. Hotel, Hadyai.

Sumit Kunakorn. (1980). Curriculum and Teaching. Fourth Edition. Faculty of Education, Chulalongkorn University.

_____. (1965). Curriculum and Teaching. Bangkok : Krungsiam Printing.

Sumon Amornwiwat, Sompong Jitradab. (1988). Context and Activities on Curriculum and Teaching in Elementary Education. Bangkok : Chulalongkorn University Press.

Sunand Srichatrapimuk. (1981). Training and Personnel Development. Bangkok : Thamasart University Press.

Surapol Jantrapat. (1986) Learning and Training Climate. Bangkok : Office of Promotion and Training. Kasetsart University.

Surat Silapa-anonda. (1998) Seminar Article on Rung-a-run Projct. (17 March 1998). Bangkok : Adison Hotel.

Taba Hilda. (1962). Curriculum Development : Theory and Practice. New York : Harcourt, Brace World.

Tanner, D. & Tanner, L.N. (1980). Curriculum Development : Theory into Practice. 2nd ed., Macmillan Publishing Company.

Tasanee Musikchai (1996) "Traning Administration" Article on developmental Administration. (Special Issue) 140-184.

Temduang Ratana-tasane and Varaporn Srisupan. (1991). Man, Environment and Environmental Education. Nakhorn Pratom : Continueds Education Project Mahidol University.

Thai Environmental Institute. (1997). "Come to Know Youth Assembly for Conservation of Energy and Environment". Rung-a-run Article. No.1 Vol.6, 19-20.

_____. (1998). Seminar Article on Rung-a-run Project. (17 March 1998), Bangkok : Adison Hotel

_____. (1998). Seminar Article on Rung-a-run Project. (17 March 1988). Bangkok : Adison Hotel

Thamrong Bausri (1961) Curriculum Theory. Bangkok : Mongkol Publisher.

Thavatchai Chaijirachayakul. (1986) Development of Curriculum from Theory to Practices. Bangkok : Aksorn Bandit.

Thurstone, L.L. (1967). "Attitude Can Be Measured". Attitude Theory and Measurement. New York : John Wiley and Sons. Inc.

Tisana Kaemanee. (1981) "Evaluation of Curriculum" Development of Colleges and Universities Curriculum. Bangkok : (Mimeogroaphed).

Tongchai Jaruppat and Jirawan Jaruppat. (1997). The Use of Lansat – 5 TM Image to watch the change of mangrove forest in Thailand. Supplementary Document for Seminar on NATIONAL Mangrove Forest the 10th (25-28 August 1997). Songkla : J.B. Hotel, Hadyai.

Udomsil Sri-Sangnam and Suvan Voravan. (1987). Handbook of Family Education Thailand Family Planning Society under the patronage of His Majesty the King's Mother. Bangkok : Style Partnership.

UNEP. (1994). Environmental and Related Issues in the Asia-Pacific Region. Bangkok : Nettlap Publication No.1 : 1.

UNESCO (1992). New Frontiers for Designing and Implementing Environmental Education Programs. Report of a Rountable, UNESCO principal Regional office for Asia and the Pacific, Bangkok.

_____. (1977) Regional Meeting of Experts on Environment Education in Asia To International Environmental Education Program. N.p.

_____. (1976). "The Belgrade Charter" . Connect. Vol.1 No.1 (January 1976) : 2-6.

_____. (1982). Regional Workshop on Environmental Education in Asia and Oceania Bangkok 22-29 September 1980. Bangkok : UNESCO.

_____. (1990). Report of Regional Training Course for Science Teachers and Supervisors on Environmental Education in The ASEAN Region. UNESCO Principal Rational office for Asia and the Pacific.

UNESCO-UNEP, (1991). Environmental Education for university Students. Connect, 19 (3).

Vichai Vongyai. (1982). Development of Curriculum and Teaching – New Dimension. Bangkok : Odeanstore.

_____. (1990). Development of Curriculum in Complete Cycle. Bangkok : Faculty of Education, Srinakarinwirot University, Prasanmitr.

Vichian Chewpimai. (1985) Training and Personnel Handbook. Bangkok : Kurusapa.

Vichit Suratreungchai. (1991). Development of Training Curriculum on Knowledge and Prevention of Aids for Elementary Teachers. Doctoral Thesis, Graduate School, Srinakarinwirot University, Prasanmitr.

Vinai Veeravatnanond and Bancheun Seepunpong. (1996). Environmental Education, Educational for Development. Bangkok : Songsiam Co., Ltd.

Vinai Veeravatnanond and Others. (1997). Environmental Education of Asian Indochina. Nakornpatom : Faculty of Social Sciences and Humaniies, Mahidol University.

Vinai Veeravatnanond. (1987) Environmental Education. Bangkok : Odeanstore.

Viola, M. (1970). Camp Counseling. W.B. Saunder Company.

Waleerat Supanan. (1997). The Development and Implementation of field Trip Teaching Manual Titled "The Conservation of Natural Resources and Environment" for Lower Secondary School Students. Master degree thesis in Environmental Education. Graduate School, Mahidol University.

Wals, A. (1992). Young Adolescents' Perceptions of Environmental Issues : Implications for Environmental Education in Urban Settings. Australian Journal of Environmental Education.

Webster (1974). New World Dictionary. New Delhi : Oxford & IBM Publishing co.

Yod Keereerat. (1997). How to Sustainably Conserve Mangrove Forest. Suplementary Document for Seminar on National Mangrove Forest 10th. 25-28 August 1997. Songkla : J.B. Hotel Hadyai.

APPENDIX A

1. List of Experts
2. List of Educators and Teachers
3. List of Academic Personnel
4. Analysis of data for efficiency of the tests
5. Analysis of Training Output

List of Experts

1. Mr. Prasop Jantaket	Curriculum expertise Center for Curriculum Development Department of Curriculum and Instruction Development
2. Mrs. Nuntiya Boonkleub	Vice-Director The Institute for the Promotion of Teaching Science and Technology, Ministry of Education.
3. Miss Savitree Srisok	Leader of Environmental Quality Promotion section, Ministry of Science, Technology, and Environment
4. Dr. Sonjai Havanond	Group Leader of Mangrove and Swamp Forest Department of Royal Forestry, Ministry of Agriculture and Cooperatives
5. Dr. Pattaraboon Pitchayapaidboon	Doctoral advisor in Environmental Education, Faculty of Social Sciences & Humanities Mahidol University.

List of Educators and Teachers

1. Miss Sriprapa Sontikunt	Head of Surpervision Unit, Office of Elementary Education Samutprakarn Province.
2. Mrs. Suree Keawses	Head of Supervision Unit, Department of General Education Samutprakarn Province.
3. Mr. Surat Atanavanich	Principal of Saklasutira upatum School Prasamutjedee District Samutprakarn
4. Mr. Sunti Sungtong	Vice Provincial Fishery, Office of Provincial fishery, Samutprakarn
5. Mr. Kreang-grai Boonleun	Academic Forestry, Office of Provincial Forestry, Samutprakarn
6. Mrs. Marisa Ko-seya-yotin	Research Leader Center for Training and Thai Occupation Development , Department of Non-Formal Education Ministry of Education.
7. Mr. Songkun Juntajorn	Vice Director, Institute of Northeastern Arts and Culture, Mahasarakam University.
8. Mrs. Nopporn Manoppongs	Teacher C.8, Rajavinitbang-keaw School, Bangplee District Samutprakarn.
9. Miss Sudjai Teppituksuk	Teacher C.7, Had-amara aksornluk vitaya School Muang District, Samutprakarn
10. Mr. Thamnoon Unsiri	Teacher C.7, Saklasutera-upatum School Prasamutjedee District Samutprakarn.

List of Training Personnel

1. Mrs. Nopporn Manoppongs — Teacher C8, Rajavinitbang-keaw School Bangplee District Samutprakarn

2. Miss Sudjai Tepituksuk — Teacher C7, Had-amara aksornluk vitaya School Muang District, Samutprakarn

3. Miss Ludda Saipantong — Teacher C7, Bang-keawprachasan School Bangplee District, Samutprakarn

4. Mr. Rawin Sukontasupya — Teacher C7, Saklasutera upatum School Prasamutjedee District, Samutprakarn

5. Mr. Somchai Sang-tanom — Teacher C7, Saklasutera upatum School Prasamutjedee District, Samutprakarn

6. Mr. Thamnoon Unsiri — Teacher C7, Saklasutira upatum School Prasamutjedee District, Samutprakarn

7. Airforce Colonel Prateep Tuntiwat. The sixth Flight Headquarter Airforce

8. Navy Commander Kwanchai In-gnwang. Deputy Commandant Phra Chulchomklao Fort

9. Navy Sublicutenant Suchart Sud-saneha, Educational personnel Phra Chulchomklao Fort

10. Mrs. Tunyaporn Pootong — Editor, Secondary Education Texts and Youth Books, Thaiwatanapanich

Analysis of Data for Efficiency of the Test

Efficiency of the achievement test on knowledge

1. Discrimination Power and Degree of Difficulty

Formular : $P = \frac{P_H + P_L}{2n}$

$r = \frac{P_H - P_L}{2n}$

2. Discrimination Power of the attitude test

Formular : $t = \sqrt{\frac{n(\bar{X}_H - \bar{X}_L)^2}{S_H^2 + S_L^2}}$

3. Reliability of the test on knowledge and skill test

Formular : Kuder Richardson Formular 21

$$r_{tt} = \frac{K}{K-1}\left\{1 - \frac{\bar{X}(K-\bar{X})}{KS_t^2}\right\}$$

4. Reliability of the attitude test

Formular : Alpha Coefficient of Cronbach

$$r_{tt} = \frac{K}{K-1}\left\{1 - \frac{\sum S_i^2}{S_t^2}\right\}$$

Analysis of Training Output

1. Average scores of Pre-test and Post-test of the first group (outside project area) and the second group (within the project area) use formular :

Formular : $t = \dfrac{\sum D}{\sqrt{\dfrac{N\sum D^2 - (\sum D)^2}{N-1}}}$

2. Comparison of average scores on pre and post test of both groups

2.1 F-test formular :

$$F = \frac{S_1^2}{S_2^2} \sim F_{n_1 - 1, n_2 - 2}$$

2.2 t-test formular :

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{S_P^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \sim t_{n_1 + n_2 - 2}$$

When $S_P^2 = \dfrac{(n_1 - 1)S_1^2 + (n_2^2 - 1)S_2^2}{n_1 + n_2 - 2}$

APPENDIX B

Hand book

HAND BOOK

MANGROVE FOREST ENVIRONMENTAL EDUCATION TRAINING SAMUTPRAKARN PROVINCE

FOR

THE LOWER SECONDARY SCHOOL STUDENT

EXPLANATION

This is a training curriculum handbook on the environment of the mangrove forests of Samutprakarn province for expert educators to use in the training program which is composed of:

1. Training curriculum on EE of mangroves
2. Content and description
3. Practical lessons
4. Training evaluation
5. Training program

Implementation of the training curriculum has been explained in the text which has been approved by the expert committee and the teachers.

It is the hope that the training curriculum will be useful to train the students on environmental education of mangroves at Saklasutira upatum School.

TRAINING CURRICULUM OF EE OF MANGROVES

Principle and Rationale

Mangrove forests have long been associated with the lives of Thai people since mangrove products have many advantages such as producing the best charcoal of its kinds which can make hundreds of million of Baht each year as an export good. Mangroves are very important to marine fishery; they provide shelter and food sources for small fish and new- born marine creatures and sea-coast farming. Unfortunately deterioration of mangroves is increasing even though the government canceled the concessions of mangrove forests in 1996. Finally, the National Economic and Social Office declared that Thailand should have the mangrove areas of no less than 1.05 million Rai by the end of 2001.

Year	Existing Mangrove Forest Area during 1961 – 1996		
	Sq. km	Existing Area (Rai)	% of Total land
1961	3,679	2,299,375	0.72
1975	3,127	1,954,375	0.61
1979	2,873	1,795,625	0.56
1986	2,964	1,227,675	0.38
1991	1,736	1,085,050	0.34
1993	1,681	1,054,266	0.33
1996	1,676	1,047,390	0.33

Source : Thongchai Jaruppat and Jirawan Jaruppat, (1997 : I – 9(6)

In 1990, the Department of Land Development reported that Samutprakarn had a mangrove forest area covering over 12,030 Rai. After Samutprakarn was promoted as an industrial site, there was subsequent development allowing marine communication and large vessels to be ported and the extension of sea-coast farming and nursing over the sea-shore areas. In 1996, images from LANDSAT 5^{TA} indicated that Samutprakarn had only 1,857.50 Rai of mangrove forests remaining (Ibid, 1997). This is due to the fact that Samutprakarn has not been declared a National Park, which would protect the land.

An effective way to solve the mangrove problems and promote sustainable restoration of mangrove forests is the cultivation of awareness and the sense of responsibility and partnership of the students in schools from lower secondary education on through the high school level. This concept coincides with the Office of Policy and Planning, Ministry of Science and Technology (1977), which has urged youngsters and the public to know about and understand the environment.

In the past decades, the process of EE could not encourage the development of understanding and knowledge about the environment among students, especially concerning partnership in community problem- solving, which is viewed negatively, and students' attitude towards conservation of natural resources, which is nill. (Kesara Pitayapanu : 1995)

Training every member of society is very important. Training everybody breaks down barriers and builds relationships. This is the core strength of

development of the training curriculum on mangroves and outdoor education for lower secondary grade school students which coincides with Fien and Tilbury (1996) who stated that EE should be study about the environment for the benefit of the environment. Therefore the experiment to implement the training curriculum with students at Saklasutira-upatum School in Samutprakarn is implemented with the belief that the training and partnership activities of the students to restore and reforest the mangrove forests will cultivate and develop the sense of awareness, responsibility, and partnership in solving environmental problems and foster a willingness to protect their environment along with community members.

Objectives of the Curriculum

General Objectives

Training the students and public to know, understand, and to develop skills and a positive attitude toward participation in conservation and restoration of mangrove forests.

Specific Objectives

1. To educate the trainer with knowledge and understanding of the mangrove environment.
2. To cultivate the attitude of the trainer towards restoration of mangrove forests.
3. To develop skills and practices in conservation and restoration of mangrove forests.

Content

The training EE curriculum on mangroves for lower secondary education students is composed of:

1. Basic knowledge on EE
2. Mangrove ecosystem
3. Advantages and value of mangrove
4. Mangrove status, problems, and effects
5. Method of mangrove conservation

Training structure

The training structure is divided into two components:

1. Theory. Discussion and lecture on mangrove EE, basic knowledge on EE, mangrove ecosystem, advantages and value of mangroves, mangrove status, problems, and effects and method of mangrove conservation.

2. Practices. Activities have been organized to coincide with outdoor education and field practices:

2.1 Learning station. Six spots in the school landscape have been selected and organized as learning stations:

2.1.1 Path walk

2.1.2 Mangrove collective station

2.1.3 Experimental station

2.1.4 Mangrove nursery station

2.1.5 Rhizopora forest station

2.1.6 Bird watch station

2.2 Field studies. Studies the sea-coast plants and mangroves along the channels in order to teach the concepts of restoration and conservation.

Time duration

This is a short course training program for two days; 3 hours are allocated for the theoretical component and 9 hours are allocated for field practices.

Training Plan Theory Component

Information center for mangrove forest station

Behavioral Objectives:

1. Be able to define the meaning and types of environment
2. Be able to explain the principles and objectives of EE
3. Be able to define and specify the physical structure of mangrove forests
4. Be able to identify elements of the mangrove ecosystem
5. Be able to explain foodchain and transformation of energy in the mangrove ecosystem
6. Be able to identify advantages and the importance of mangroves
7. Be able to identify problems and effects of the mangrove forest.
8. Be able to explain status and problems of mangroves in Samutprakarn.
9. Be able to identify the guidelines to conserve mangrove forest
10. Be able to classify the personal ability of individual members in the training group regarding conservation of mangroves

Attitude

After participation in this training program, the students should be able to develop the following activities and behaviors:

1. Protect organisms of mangrove forests
2. Protect mangrove from deterioration
3. Protect the mangrove condition and status
4. Greet those who conserve the mangroves
5. Participate in mangrove activities and conservation as much as possible

Skills

1. Be able to identify sea-shore plants and mangroves
2. Be able to use thermometer and litmus paper to measure temperature and type of soils
3. Be able to take notes and information records
4. Be able to predict the situation of mangroves
5. Be able to translate recorded data into written explanations
6. Be able to identify mangrove problems, and plan to protect mangroves.

Content

1. Basic knowledge on EE
   - 1.1 Meaning and types of environment
   - 1.2 Meaning and Objectives of EE
   - 1.3 Principle of EE
2. Mangrove ecosystem
   - 2.1 Elements of mangroves
   - 2.2 Elements of the mangrove ecosystem
   - 2.3 Functions and activities of the mangrove ecosystem
3. Advantages and value of mangroves
   - 3.1 Importance of mangroves
   - 3.2 Advantages of mangroves
4. Status of mangrove and its effects
   - 4.1 Problems and the causes of mangrove deterioration
   - 4.2 Status of mangroves in Samutprakarn and its effects
5. Ways to conserve mangroves
   - 5.1 Meaning of conservation
   - 5.2 Participation and partnership in mangrove conservation
   - 5.3 Management policy to conserve mangroves

Training Activities

1. Introduction to training program (Lecture from experts)
2. Group relationship activities and forming small groups
3. Discussion and lecture on materials and media.

Training media

1. Training handbooks
2. Slides
3. Transparencies
4. Videotape

Evaluation

1. Pre-test of training
2. Participation in activities and participant observation

Time required: 3 hours

Practice Part.

Station 1. Path Walk

Main Idea:

Plants and animals in mangroves are grouped to be a community in which each individual has associated and close relationships.

Behavioral Objectives:

1. Be able to identify characteristics and advantages of Nypa palm
2. Be able to identify characteristic and advantage of Sa-mea trees *(Avicennia)*
3. Be able to identify species and advantages of mangrove marine animals
4. Be able to identify species and disadvantages of weeds in mangrove forests.

Content

1. Nypa palm forest
2. Sa-mea forest *(Avicennia)*
3. Top-tap trees *(Derris trifoliata)*
4. Mangrove marine animals

Training Activities

1. Trainees study mangrove plant communities
2. Trainees study mangrove marine animals
3. Answers to the worksheet

Materials and medias

1. Content sheet
2. Study points
3. Worksheet

Evaluation

1. Worksheet
2. Observation and discussion

Time required: 30 minutes

Station 2. Mangrove Collective Station

Main Idea:

Diversity of mangrove lives have a unique characteristic for existence.

Behavioral Objectives :

1. Be able to identify no less than 5 mangrove plant species
2. Be able to identify the dominant characteristics
3. Be able to identify mangrove plants distribution

Content

1. Young mangrove plants in Samutprakarn
2. Mangrove plants propagation

Training Activities

1. Study from content sheets
2. Field observation at specified stations
3. Answers to the worksheet

Materials and medias

1. Content sheet
2. Specified learning station
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required: **30 minutes**

Station 3. Experimental Station

Main Idea :

Physical factors of mangroves are very important to the lives of plants and animals. Their growth, distribution, and all life activities rely on the mangrove.

Behavioral Objectives:

1. Be able to check and observe physical properties of soil
2. Be able to check and observe physical properties of water
3. Be able to check and observe general conditions of climate

Content

Study physical structure of mangroves, soil, water and climate

Training Activities

1. Study from content sheet
2. Observe, check, and experiment
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Thermometer
3. Chemical substance to test soil and water
4. Litmus paper
5. Test tubes

Evaluation

1. Worksheet
2. Results of the experiments

Time required: 30 minutes

Station 4. Mangrove Nursery Station

Main Idea:

Nursing new plants from seeds for plantation requires natural knowledge of each plant and nursing techniques.

Behavioral Objectives:

1. Be able to prepare soil and bags for planting
2. Be able to conduct plantation of new plants

Content

1. Prepare new mangrove nursing plants and soil bags
2. Demonstration of the nursing of new mangrove plants

Training Activities

1. Preparing soil demonstration
2. Trainees practice on soil preparation
3. Demonstrate new plant plantation
4. Trainees practice planting new mangrove plants

Materials and medias

1. Worksheet
2. Content sheet
3. Nursing plants
4. Soil bags
5. Materials for nursing

Evaluation

1. Worksheet
2. Participant observation

Time required: 30 minutes

Station 5. Rhizophora Forest Station

Main Idea :

Rhizophora has a unique characteristic in that it can grow in tidal salty muddy water, but the first three years of growth require care.

Behavioral Objectives:

1. Be able to identify root, stem, and leaf parts of Rhizophora
2. Be able to identify the animals which destroy Rhizophora in the experimental plot
3. Be able to explain how to care for mangroves

Content

1. Growth of Rhizophora
2. Characteristics of Rhizophora
3. Care and maintenance of mangrove forests

Training Activities

1. Study from content sheet
2. Study basic information from mangroves
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Learning station in the mangrove forest
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required: 30 minutes

Station 6. Bird Watch Station

Main Idea:

Birds are winged animals within the mangrove habitat. They are very important in the balance of nature and exhibit colorful features.

Behavioral Objectives:

1. Be able to identify advantages of birds in the ecosystem
2. Be able to identify species of mangrove birds

Content

1. Birds in mangrove forests
2. Advantages of birds in the mangrove ecosystem training activities

Training Activities

1. Study from content sheet
2. Bird watch at specified location
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Study station
3. Binoculars
4. Articles and bird watch handbooks

Evaluation

1. Worksheet
2. Participant observation

Time required: 30 minutes

Field Study

Main Idea:

Erosion of mangroves by tides and wind creates natural damage, but the more serious damage stems from human activities.

Behavioral Objectives:

1. Be able to identify mangrove species along the channel and in the community
2. Be able to identify occupations of the people in the community as they affect the mangrove forest.
3. Be able to explain effects of mangrove deterioration.

Content

1. Mangrove plant species along the channels and in the community
2. Activities of people in the mangrove community
3. Deteriorated areas along the sea-shore, mouth of the river and channels

Materials and medias

1. Content sheet / Worksheet
2. Specific sites of the channels, community and the mouth of rivers
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation during field studies
3. Discussion after field studies

Place : Pracholchomkloa Port, Samutprakarn province

Time required: 3 hours

Recommendations for the Implementation of Training Curriculum

1. Organization of training program should be clearly stated :
   - 1.1 Rationale and principles
   - 1.2 Training objectives
   - 1.3 Content and training activities
   - 1.4 Training process and management
   - 1.5 Methods of evaluation
   - 1.6 Time requirement
   - 1.7 Time schedule
   - 1.8 Staff and trainers team
   - 1.9 Trainees
   - 1.10 Funding and budget
   - 1.11 Training facility needs
2. The site of training should be sea-coast or sea-shore where mangroves and tidal plants are growing naturally.
3. Training time should be on weekends or during school holidays
4. The training participants should be :
   - 4.1 Lower secondary school students
   - 4.2 Group of trainees should be no larger than 60 students each
   - 4.3 Careful pre-planning and advance communication with trainees
5. Trainers and experts should be carefully selected:
   - 5.1 Qualified and expert educators in EE with sufficient experience with mangroves as the focal issue of the training program
   - 5.2 Seven to nine qualified and expert educators should be available at all times during the training session
   - 5.3 Qualified and expert educators to join the training program should be notified in advance with enough time to allow for their preparation
6. Training fund and budget

The cost of the 2-day training program with 60 trainees, 9 qualified expert educators, and 5 personnel will be about 30,000 Bath.

Recommendation for the Training Process and Management

1. Training sites should be divided into separate areas; one for discussion and academic display, and the other for field studies and practices.

2. During lecture and discussion sessions, all trainees should attend at the same time. During field studies and practical sessions, the trainees will be broken into small groups of 10 trainees who will rotate their activities according to the specific schedule at each learning station. Each group will spend 30 minutes at each station with the exception of field trips where all trainees will study as a group.

3. The discussion and lecture processes should coincide with the practical sessions:

3.1 Discussion and lecture should coincide with materials and medias

3.2 Discussion must include the opportunity for the trainees to express their thoughts and conflicts

3.3 Group processes are the main focus within the small group practical sessions

3.4 After finishing field practices, each group must present their results to the whole group for evaluation

This training of EE curriculum emphasizes field practices, or outdoor education in a short course of two day duration, therefore the trainer educators should uphold these principles:

1. Integrate the local problems as the content of basic knowledge
2. The trainer is the center of learning knowledge
3. Field practices are the major activities
4. The trainers must practice and participate in the training program
5. Outdoor activities are for every trainer
6. The trainers must be experienced through direct touch and skills
7. Participation and partnership of the trainers is an important focus.

4. Materials and medias are significant, especially in learning stations in the field and during field trips.

4.1 Materials and medias required at each station must be carefully prepared to serve the practical works

4.2 Materials and medias required in the theory component and discussion, lecture, and demonstration must be available and ready to use at all times during the training session.

Evaluation of the Curriculum

Curriculum evaluation should be done in three ways :

1. Evaluate the achievement of the trainees through pre-test and post-test methods. The tools to measure achievement are the Test of Basic Knowledge on Mangrove, the Attitude Test towards Mangrove Conservation, and the Skills Test on Mangrove Conservation.

2. Evaluate the implementation of the curriculum through questionnaires administered to the expert educators and trainees.

3. Follow-up evaluation: The trainers should be able to present the restoration and mangrove conservation plans within 1-2 months after training has ended.

MANGROVE ENVIRONMENTAL PRACTICES LESSON

Practices lessons composed of 6 field study stations and field trip:

1. Path Walk
2. Mangrove Collective Station
3. Experimental Station
4. Mangrove Nursury Station
5. Rhizophora Forest station
6. Bird Watch Station
7. Field Study

The trainees will be broken into six groups of ten students. They will rotate to the six stations and spend 30 minutes at each station. Then all students will participate in the field trip to study sea-cost and mangroves. The follow-up portfolio will be evaluated immediately following the training and at 1-2 months after the training.

Station 1. Path Walk

Main Idea :

Plants and animals in the mangrove forest are grouped to be a community in which each individual has associated and close relationships.

Behavioral Objectives:

1. Be able to identify characteristics and advantages of Nypa palm
2. Be able to identify characteristic and advantage of Sa-mea trees *(Avicennia)*
3. Be able to identify species and advantages of mangrove marine animals
4. Be able to identify species and disadvantages of weeds in the mangroves

Content

1. Nypa palm forest
2. Sa-mea forest *(Avicennia)*
3. Top-tap trees *(Derris trifoliata)*
4. Mangrove marine animals

Training Activities

1. Trainees study mangrove plant communities
2. Trainees study mangrove marine animals
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Study points
3. Worksheet

Evaluation

1. Worksheet
2. Observation and discussion

Time required: 30 minutes

Content Sheet

1. Path Walk

Nypa* Palm *(Nypa fruticans)

Nypa palm is a plant of the Palmae family the same as co-co nut palm. It has compound leaves as feathers about 6-7 meter long, a leaflet 1 meter long, a stern underground as a rhizome, and a fibrous root system to anchor the stern against tides.

Stem growth occurs along a horizontal line circulating the old stem. It has alternate leaves, flower shoots among the cones of the leaves at about 90-100 cm, cream colored amle flowers spread over the flower stalk, but the stalk flower is pink so that people call it "Bird". This is the edible part; the female flower is on the center of the round fruit and is brown in color and is whole. The fruit tissue is strong fiber with an air pole for floating.

The embryo grows out from the seed before being dropped off the whole stem. Pollination is by the insect is drosophila and the cycle can be completed in the male stalk. Distribution is along saline water, but not in areas with salty water and strong wind. It grows well in tidal saline water. (Wongchan Wonkeaw : 1997. I – 8)

Advantage

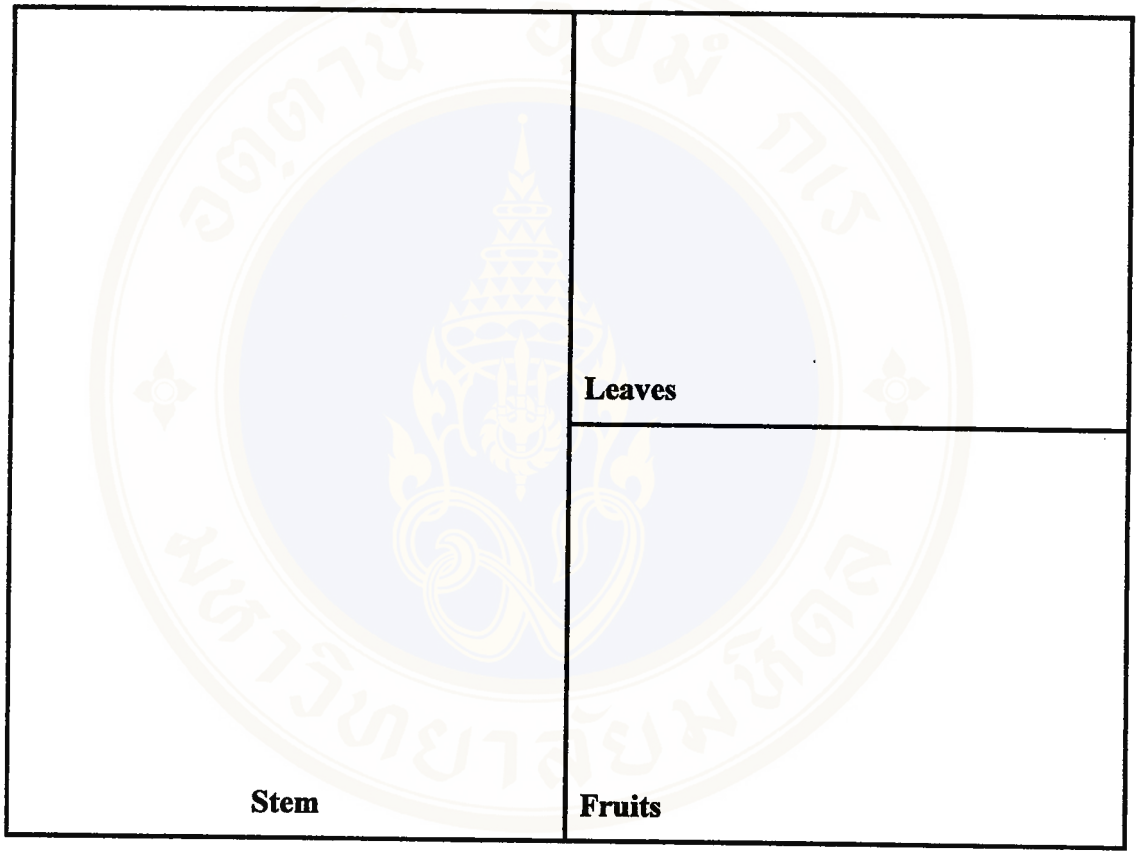
1. Shelter for marine animals
2. Food sources
3. Protect sea-coast from soil erosion

Work Sheet

Nypa Palm Forest

Observe characteristics of *Nypa palm* and draw the specified parts:

1. Characteristics of *Nypa palm*



2. Advantages of *Nypa palm* :

☐	Food source	☐	Protect from soil erosion
☐	Shelter	☐	Poisonous
☐	Medicinal plant	☐	Animal sheter
☐	Shading	☐	Animal food

Other,specify.....

.....

.....

.....

Content Sheet

Sa-mae Forest *(Avicennia)*

Sa-mae is a middle shrub of Avicenniaceae. There are three species found in Thailand: *A. marina*, *A. alba* and *A. officinallis*

A. marina is found on newly accumulated muddy land. It has pale yellow leaves, back curve to dorsal which looks like curling leaves, a white to gray stem, yellow to orange flowers, and fruit in the shape of a heart.

A. alba is found along muddy channels or sea-coast in blackish muck. It has small and grayish leaves, a black stem, yellow flowers, and long fruit like chili fruit.

A. officinallis has a brown stem, broad leaves, entire, ovate opex, green ventral, grayish dorsal, yellow to orange flowers 10-15 mm large, and heart shaped fruit.

Sa-mae can grow on the waste land either in fresh or tidal salt water. The tap root system is spaced out around the stem to support the stem on the muck and muddy land. Its numbers of airral roots shoot up from underground around the stem.

Advantage

1. Shelter, nest and animal distribution
2. Food source for animals
3. Wood for fuel
4. Medicinal plant
5. Ecological system protection

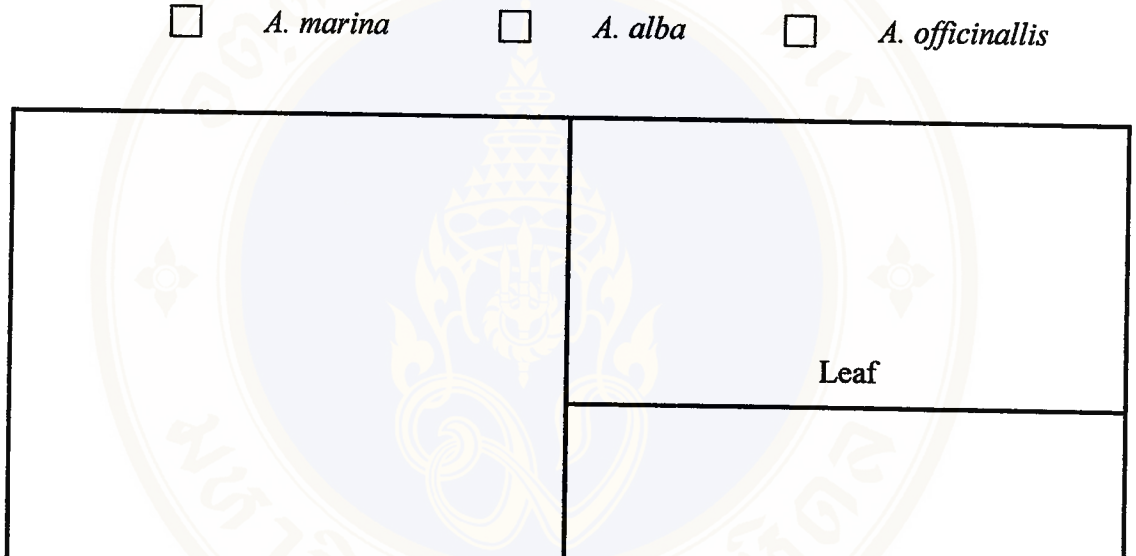
Work Sheet

Sa-mae Forest *(Avicennia)*

Observe characteristics of *Avicennia*, study detail from content sheet, and draw the specified parts of *Avicennia*:

1. Characteristics of *Avincennia*

☐ *A. marina* ☐ *A. alba* ☐ *A. officinallis*



2. Identify advantages of *Avicennia*

☐	Food	☐	Protect sea-coast fromsoil erosion
☐	Shelter	☐	Toxic
☐	Medicinal plant	☐	Nest
☐	Shading	☐	Animal food

Other specify .....

.....

.....

.....

Content Sheet

Top-Tap *(Derris trifooliata)*

It is a climbing plant found along the ground in tidal areas, hard soil or waste land. Its leaves are heart shaped like fig leaves; it has greenish leaves with a yellow mid rib. New born sprouts have a single leaf but change to triflora when grown up. It has a fibrous root system, and is a sunny plant.

Advantages

Shelter for small animals, food for caterpillar, insects, and crabs, basic foodchain for ecosystem

Disadvantages

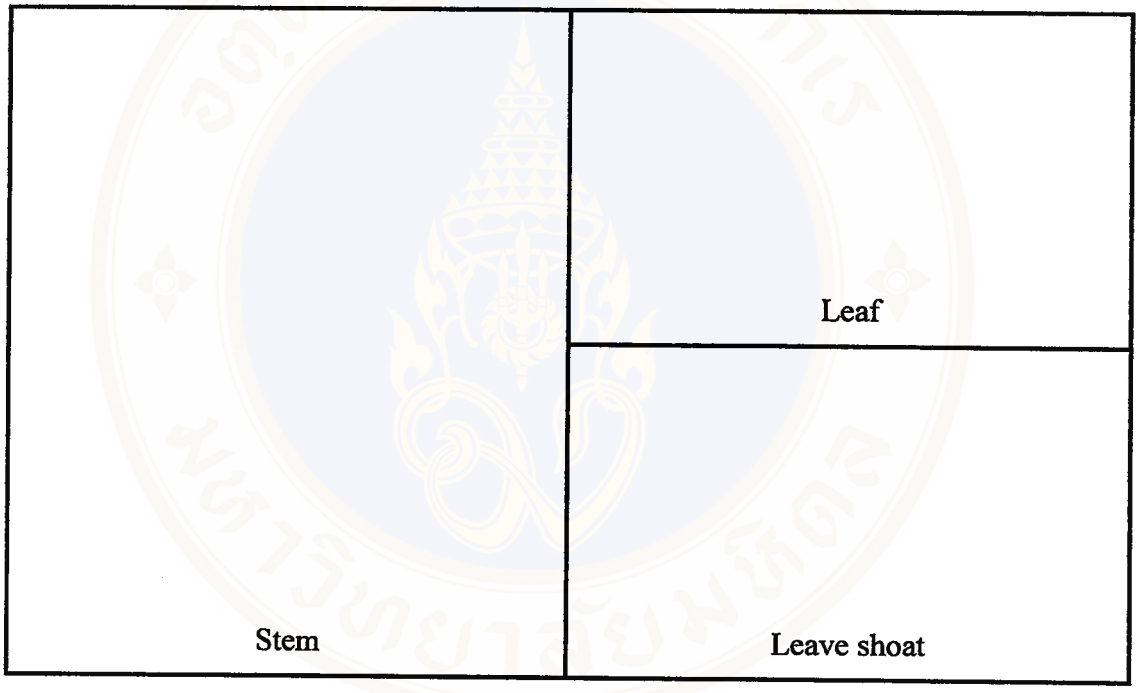
Great nuisance binding weed for new mangrove plantation. They can grow to cover the area in a short time.

Work Sheet

Top-tap *(Derris trifoliata)*

Observe characteristics of *Derris trifoliata*, study the detail and content sheet, then draw the specified parts of Top-Tap.

1. Characteristics of Top-Tap



2. Identify advantages and disadvantages of Top-Tap

☐	Food	☐	Soil surface protection
☐	Shelter	☐	Toxic
☐	Medicinal plant	☐	Nest
☐	Shading	☐	Animals food

Other specify .....

.....

.....

.....

Content Sheet

Mangrove animals

Mangroves coexist with all kinds of marine animals such as shrimp, mussel, crabs, and fish which are important economically, socially, and to the sea-coast ecosystem.

There are at least fifteen species of shrimps found in mangrove areas; thirty species of crabs; four species of mussels; twenty two species of mollusks; seventy-two species of fish which can divided into four groups: permanent living fish, temporary living, seasonal fish, and water blow- in fish. Bipaddy fish and bamboo fish are very common on the must muddy of mangroves.

Advantage

1. Good protein food sources
2. Important export goods
3. Ecological importance
4. Education and research sites

Work Sheet

Mangrove Marine Animals

Study species of mangrove marine animals from the content sheet, observe marine animals at learning stations, draw the specified species and answer the questions.

1. Found marine animals

☐ Shrimp ☐ Crab

☐ Mussel, Snail ☐ Fish

2. Characteristics of found animals

Shrimp	Mussel, Snail
Crab	Fish

3. Relationship among plants and animals in foodchain

Station 2. Mangrove Collective Station

Main Idea :

Diversity of mangrove lives have a unique characteristic for existence.

Behavioral Objectives :

1. Be able to identify no less than 5 mangrove plant species
2. Be able to identify the dominant characteristics
3. Be able to identify mangrove plant distribution

Content

1. Young mangrove plants in Samutprakarn
2. Mangrove plant propagation

Training Activities

1. Study from content sheets
2. Field observation at specified stations
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Specified learning station
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required: **30 minutes**

Content Sheet

Mangrove Collective Station

Mangrove Plants

There are a number of species of plants growing in mangrove areas. Most of them are deciduous plants and have similar physiology and structure including high resistance to salty marine water. There are at least seventy-four species; dominant groups would be *Rhizophora, Ceriops, Bruguiera, Sonneratia, Avicennia, and Xylocarpus.*

There are twenty-three species of mangrove plants in abundance within the Saklasutira-upatum school ground area which students will study:

1. ***Rhizophora apiculata*** (Small leaves Rhizophora) bi-flowers of each flower shoot, bract leaf joint together as cup. No hair on sepal, strong stem with numbers of stilt roots
2. ***Rhizophora-mucronata*** (Large leaves Rhizophora) Three-five flowers of each flower shoot, separate bract leaves, hairs on sepal, strong stem with numbers of stilt roots.
3. ***Pluchea indica*** Inflorescence flowers about 18-12 mm. long, 7-9 mm. sepals.
4. ***Avicennia marina*** round fruit without spur, ovate leaves, round apex, dorsal greenish
5. ***Avicennia alba*** oval fruit with spur, spear shape leaves, dorsal greenish.
6. ***Avicennia officinallis*** short oval fruit, round apex leaves, ventral waxy, dorsal brownish.
7. ***Asonneratia caseolaris*** flat shape fruit, flower bract stick on fruit, oval leaves rond apex, large and tall stem.
8. ***Xylocarpus granatum*** pale brownish brak broken as scar, oval leaves round apex, round hard shell fruit.
9. ***Acanthus ilicifolius*** prop roots system, Thorny leaves and stem, serrate leaves, flower purple, small round fruit at the base of flower stalk.

10. Acanthus ebracteatus prop roots system, Thorny leaves and stem, serrate leaves, flower white, small round fruit at the base of flower stalk.

Most plant species in the mangrove area are distributed by seeds or fruits, some float along the water tide while some stick into the muddy musk.

Work Sheet

Mangrove Collective Station

Study the characteristics of mangrove plant species from the content sheet, observe each species in the collection station, draw the specified pictures and answer the questions.

1. Mangrove plants found (at least 5 species)

☐ *Rhizophora apiculata*	☐ *Avicennia alba*
☐ *Rhizophora mucronata*	☐ *Avicennia marina*
☐ *Avicennia officinalis*	☐ *Asonneratia caseolaris*
☐ *Xylocarpus granatum*	☐ *Acanthus ilicifolius*
☐ *Pluchea indica*	☐ *Acanthus ebracteatus*

2. Draw characteristics of 1 species of found plant

Name of plant.....

Stem	Leaves
Roots	Flower / Fruit
Distribution ☐ Seed ☐ Pod (Fruit)	

3. Experimental Station

Main Idea :

Physical factors of mangrove are very important to the lives of plants and animals; their growth, distribution, and all life activities rely on the physical factors of the mangrove.

Behavioral Objectives :

1. Be able to measure and observe physical conditions of soil
2. Be able to measure and observe physical conditions of water
3. Be able to measure and observe physical conditions of climate

Content

Physical features of soil, water, and climate of mangrove

Training Activities :

1. Study from content sheet
2. Observe and measure by instruments
3. Answers on the worksheet

Materials / Medias

1. Content sheet / Work sheet
2. Thermometer
3. Test tubes stand
4. Universal paper
5. Test tubes
6. #1 spoon
7. Syringe 35 cm^3
8. Plastic funnel
9. 50 cm^3 Beakers
10. Filter paper
11. Glass rod

Evaluation

1. Check list
2. Experimental results
3. Practical observation

Time 30 minutes.

Content Sheet

Experimental Station

Physical features of Mangrove

Physical factors of mangroves are very important to the lives of plants and animals, to their growth, distribution, and all life activities. The major factors are geographical structure of the sea-coast, climate, high tide-low tide, waves and stream, salinity of water, dissolved oxygen, soil, and nutrients.

1. **Geographical features of the sea-coast.** Mangroves can be found along the large plane of sea-coast nearby the mouth of the rivers, or tidal zone.

2. **Climate.** Intensity of light, temperature, rain, wind is important and relates to lives in the mangrove:

Light is very important as a source of energy for photosynthesis, respiration, stomatal functioning, and transpiration.

Temperature has a direct effect on the growth of mangrove plants; optimum temperature for photosynthesis is around 25-30^0 Celsius. The average temperature of Samutprakarn is 27.7^0 Celsius annually.

Rain influences plant growth and distribution, which relies on rain water quantity and frequency of duration. The demand for rain water for average growing is 1,500-3,000 mm/annually during the 8-10 months of the rainy season. The average rain fall in Samutprakarn is 1,555.9 mm/annually

3. **High-tide Low-tide** is the sequence that effects the salinity of marine water. High-tide increases the salinity of water, while low-tide decreases the salinity of water. It is appropriate for the growth of mangrove plants if the salinity falls between 10-60%

4. **Dissolved oxygen**. Avicennia, Asonnerratia, and some mangrove plants have airal roots to receive oxygen for respiration. In addition, the decomposers of debris also require oxygen.

5. **Soil:** muddy musk with P_H value about 4-7 is appropriate to the growth of mangrove plants.

Work Sheet

Experimental Station

Study the physical features of mangroves from the content sheet, and test the following factors :

Light: criteria to measure as high, moderate, and low by assuming that light in the classroom on a clear day is of moderate intensity

Temperature: measure air temperature at your waist, measure water temperature at the middle point of the water depth, and measure soil temperature at 15 cm deep.

Soil condition: observe and test the pH level of the soil by digging the surface soil with #1 spoon for 5 spoonfulls, pour into distilled water 20 cm^3, shake well, and pass through filter paper; test the filtered water with pH paper and check the color with the standard chart.

Water condition: observe the high-tide, low-tide levels; take the water in the specified area, pour into test tube about half full, and test with pH paper. Do the same as the soil test.

Record of observation of the experiments

Area condition	Light	Temp ^0C	Soil	Water
☐ High tide all time	☐ High	Air.....	☐ Alkalinity	☐ Alkalinity
☐ Low tide, untidal	☐ Moderate	Soil.....	☐ Acidity	☐ Acidity
	☐ Low	Water.....		

Station 3. Experimental Station

Main Idea :

Physical factors of mangrove are very important to the lives of plants and animals; their growth, distribution, and all life activities rely on the mangrove.

Behavioral Objectives :

1. Be able to check and observe physical property of soil
2. Be able to check and observe physical property of water
3. Be able to check and observe general condition of climate

Content

Study physical structure of mangroves, soil, water and climate

Training Activities

1. Study from content sheet
2. Observe, check, and experiment
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Thermometer
3. Chemical substances to test soil and water
4. Litmus paper
5. Test tubes

Evaluation

1. Worksheet
2. Results of the experiments

Time required: 30 minutes

Content Sheet

4. Mangrove Nursury Station

The restoration or reforestation of mangroves must be carely planned from seed collection, seed germination, nursing new seedling plants in prepared bags, preparing the area for plantation, plantation and maintenance.

Nursing mangrove plants

1. **Prepare planting soil** in a 1:1 ratio between muddy soil and burned husk. Put into plastic bag
2. **Select the seeds**: Rhizophora- must select only those mature seeds, Avencinnia- select healthy seeds immersed under water for two hours then bury the seed into the prepared soil-bag.
3. **Transplantation of Rhizophora** – Immerse the pod into the prepared bag, cover about one-third of the pod
4. **Maintenance** – The transplanted bags should be set in a row on two sides of the path walk. The nursery should be located in the tidal zone.

Work Sheet

Mangrove Nursery Station

Observe carefully the soil preparation, seeds selection, burying seeds into the prepared bags from the demonstration and then practice on your own. Answer these questions:

1. Soil preparation
   - ☐ Clay with husk 1:1 ratio
   - ☐ Muddy musk with husk 1:1
   - ☐ Sandy soil with husk 1:1

2. Immerse Rhizophora pod into the prepared bag
   - ☐ 1/2 of the pod
   - ☐ 1/3 of the pod

3. Transplantation of Avicennia
   - ☐ Immerse the seed into soil
   - ☐ Immerse the seed under soil surface

4. Appropriate Nursery location
   - ☐ Untidal zone
   - ☐ Tidal zone

5. Practice transplantation by yourself: one plant each

Station 5. Rhizophora Forest Station

Main Idea :

Rhizophora has a unique characteristic in that it can grow in tidal salty muddy water, but the first three years of growth require great care.

Behavioral Objectives:

1. Be able to indentify root, stem, and leaf parts of Rhizophora
2. Be able to identify the animals which destroy Rhizophora in the experimental plot
3. Be able to explain how to care for mangroves

Content

1. Growth of Rhizophora
2. Characteristics of Rhizophora
3. Care and maintenance of mangrove forests

Training Activities

1. Study from content sheet
2. Study basic information from mangroves
3. Answers on the worksheet

Materials and medias

1. Content sheet
2. Learning station in the mangrove forest
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation

Time required: 30 minutes

Content Sheet

5. Rhizophora Forest Station

Rhizophora plantation is common in new straighten – out land and deforestation or deteriorated areas; it requires direct plantation from the pod.

For growth of *Rhizophora* under a shading area, the survival rate is about 40.97% in one year and the overage height is 47.08 cm. The stem growth is 0.63 cm. For those plantations in new muddy land, the survival rate is 39.13% in one year, and the average height is 81.55 cm. Stem growth is 1.09 cm. ***Rhizophora mucreonata*** is best growing on new muddy land.

Rhizophora has thick brownish bark, round and greenish waxy leaves, and numbers of stilt roots around the stem. ***Rhizophora mueronata*** has 3-5 flowers on each flower shoot, separate flower breacts, and hairs on the sepal. ***Rhizophora apiculata*** has two flowers on each flower shoot, flower bracts jointed together as cup, and no hairs on the sepal.

Maintenance of *Rhizophora* during the first 3-4 years of plantation is very important due to barnacles sticking on the stem, leave caterpillar and worms, and invading weeds such as Top-Tap vine and Acanthus sp.

Work Sheet

Rhizophora Forest Station

Study characteristics of *Rhizophora* Forest from the content sheet and the actual plants, then answer the following questions:

1. Where does *Rhizophora* grow ?
   - ☐ Open muddy musk
   - ☐ Shading muddy musk

2. What type of root does *Rhizophora* root have ?
   - ☐ Stilt root
   - ☐ Airal root

3. The observable enemy of *Rhizophora* is ?
   - ☐ Caterpilla, worms
   - ☐ Snail
   - ☐ Barnacle
   - ☐ Not found

4. In order to maintenance a *Rhizophroa* forest, one should ?
   - ☐ All time eradicate
   - ☐ Eradicate at least 3-4 years.

5. Rhizophora mucronata inflorescence flowers have ?
   - ☐ 3-5 flowers each
   - ☐ 2 flowers each

Station 6. Bird Watch Station

Main Idea:

Birds are winged animals within the mangrove habitat. They are very important in the balance of nature and exhibit colorful features.

Behavioral Objectives:

1. Be able to identify advantages of birds in the ecosystem
2. Be able to identify species of mangrove birds

Content

1. Birds in mangrove forests
2. Advantages of birds in the mangrove ecosystem training activities

Training Activities

1. Study from content sheet
2. Bird watch at specified location
3. Answers on the worksheet

Materials and medias

1. Content sheet / Worksheet
2. Study station
3. Binoculars
4. Article and bird watch handbooks

Evaluation

1. Worksheet
2. Participant observation

Time required: 30 minutes

Content Sheet

6. Bird Watch Station

Birds in Mangrove

There are 88 species of birds in mangrove areas, both local birds and migrating birds. The most common birds are peafowl, hawk, hornbill, swallow, warblers, sea-gull, snakebird, nigh heron, water rail etc.

Birds are very important in the mangrove foodchain and ecosystem. They also help the balance of nature since some birds are predators on rats, mices, snakes, caterpillar, worms. They help to control the population in the ecosystem. Besides that, their colors, and singing contribute to the natural beauty for human recreation and birdwatching amatuers.

Work Sheet

Birdwatch Station

Study the bird species from the content sheet, and practice bird watching at the specified point, then answer the questions:

1. By direct observation with naked eye and by using binoculars, how many species have you found?

- ☐ Snakebirds
- ☐ Hawk
- ☐ Water rail
- ☐ Worblers
- ☐ Peafowl

2. How do birds support the mangrove ecosystem?

- ☐ Eradicate plants' enemies
- ☐ Add natural beauty
- ☐ Control predators and prey
- ☐ Top level of foodchain

3. Draw a picture of your favorite bird.

Field Study

Main Idea:

Erosion of mangroves by tides and wind creates natural damage, but the more serious damage results from human activities.

Behavioral Objectives:

1. Be able to identify mangrove species along the channel and in the community
2. Be able to identify occupations of the people in the community as they affect the mangrove forest.
3. Be able to explain effects of mangrove deterioration.

Content

1. Mangrove plant species along the channels and in the community
2. Activities of people in the mangrove community
3. Deteriorated areas along the sea-shore, mouth of the river and channels

Materials and medias

1. Content sheet / Worksheet
2. Specific site of the channels, community and the mouth of rivers
3. Worksheet

Evaluation

1. Worksheet
2. Participant observation during field studies
3. Discussion after field studies

Site: Pracholchomkloa Port

Time required: 3 hours

Content Sheet

Field Study

Site of Study

1. Along the channel leading to the Port of Chulchomklaow Navy Base, there are *Nypa* forest, Sa-mae *(Avicennia),* and *Asonneratia* on the way through to the Port.

2. The Port area is surrounded by mangrove towards the Gulf of Thailand for about a thousand Rai which the public can use for shrimp farming; this has led to the deterioration of mangroves in some places. The navy has tried to enact restoration and reforestation projects.

3. The mangrove forest behind the jail along the sea-coast has been destroyed. In front of the Navy Base nearby the Museum of the Royal Maeglong Gunship, the Gulf soil has been severely eroded. The Navy stacked old tires on the post along the coast-line to protect it from erosion.

Work Sheet

Field Study

1. Observe the species of mangrove plants along both side of the road to the Port of Chulchomkloa, and answer the questions:

1.1 Species of plants along the channel

- ☐ Nypa Palm Forest
- ☐ Sa-mae *(Avicennia)* Forest
- ☐ Rhizophora Forest

1.2 Species of plants along both side of the road

- ☐ Nypa Palm Forest
- ☐ Sa-mae *(Avicennia)* Forest
- ☐ Rhizophora Forest

2. Occupation of the people which affects the mangrove

- ☐ Shrimp farming
- ☐ Mussel farming
- ☐ Fish farming

3. From the content sheet and your direct observation, the effects to the mangroves nearby the Museum of the Royal Maeglong Gunship are

- ☐ Sea – coast is destroyed
- ☐ Sea – coast is developed

Work Sheet

Conclusion / Report practice

Students group together to draw up a conservation plan within your school landscape or in the community by following this format.

Name of project

.....
.....
.....

Principle and rationale

.....
.....
.....

Objectives

.....
.....
.....

Project staff (responsibility)

1. ..... 6. .....
2. ..... 7. .....
3. ..... 8. .....
4. ..... 9. .....
5. ..... 10. .....

Method of practice

.....

.....

.....

Planning procedure

.....

.....

.....

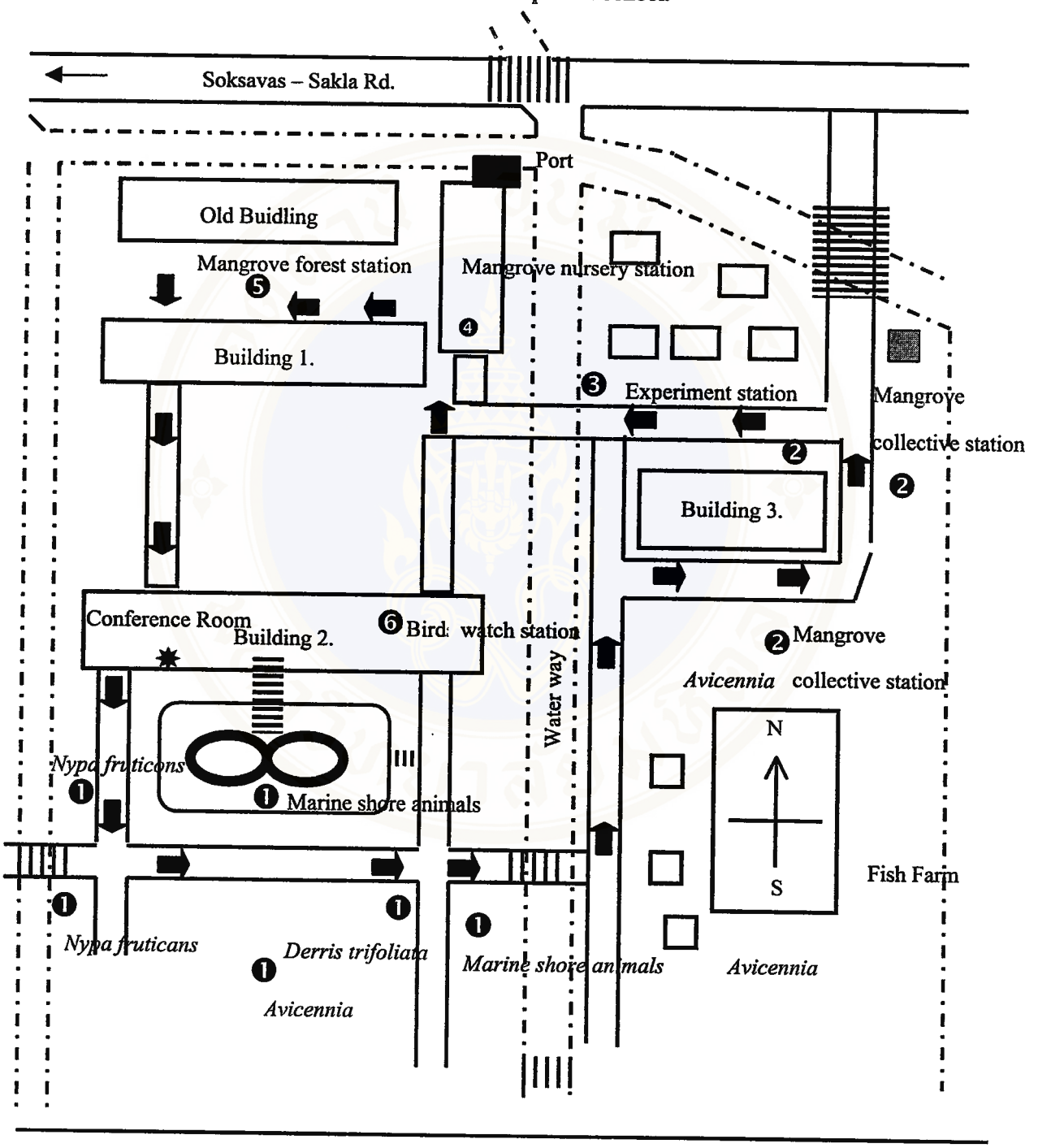
Evaluation and project follow-up

.....

.....

.....

Layout of Mangrove Path Walk



1 Path Walk Station

2 Mangrove Collective Station

3 Experiment Station

4 Mangrove nursery Station

5 Mangrove Forest Station

6 Bird. Watch Station

BIBLIOGRAPHY

Ministry of Education : Environmental Education Project (1991) Methods of Organizing Environmental Education Activities. J.N.T. partnership.

Pasinee Picumpongsanta (1991) Environmental Education : Teaching and Practices. Bangkok : Chulalongkorn University Press

Laddaval Kanhasuwan. (1992) Handbook of Environmental Teaching. Bangkok : Odean Store

Wongchan Wongkeaw. (1997) Potential of Nypa Palm in Protection of the Sea-Coast. Seminar Article on Tenth National Mangrove Ecosystem 25-28 August 1997

Vichai Eng-panjalap. (1996) Mangrove Forest. Bangkok : Thaiwata-napanij Ltd.

Vinai Veeravatnanond and Others. (1997) Environmental Education of Indo-Asian Region. Faculty of Social and Humanity, Mahidol University.

Center of Environmental Education Rajapat Pranakorn Institute (1992) Practical Lesson for Mangrove Environmental Education, Secondary Education Level.

Department of Environmental Quality Promotion. (1994) Mangrove. Bangkok : Co-operative National Agriculture of Thailand.

Sanit Aksornkoae. (1989) Ecology of Mangrove and Management. Bangkok : Compu advertising partnership.

Achievement Test on Basic knowledge of the Mangrove Environment for Lower Secondary Education Students

Explanation.

Part 1. Test of knowledge on Mangrove Environmental Education

1. This is the test of basic knowledge on the mangrove environment for lower secondary students in Samutprakarn province.
2. It is multiple choice test with 4 options on 30 items.
3. Mark X over the leter a., b., c. or d. Which is the most correct answer?
4. You have 20 minutes to do the test

Part 2. Attitude Test on Conservation of Mangrove: 5 minutes.

Part 3. Practical and Skills Test on Mangrove conservation: 5 minutes

Part 1. Test of knowledge on Mangrove Environmental Education

1. "Environment" means :
   a. Every Thing surrounding
   b. Natural Things
   b. Every Thing man-made
   d. Living Things around us
2. Which has the most effect on the environment?
   a. Humans
   b. Plants
   c. Animals
   d. Every Thing
3. Which creates the most problems for the environment?
   a. Human behavior
   b. Technology
   c. Lack of responsibility of officers
   d. Limited knowledge of environment
4. Environment can be dvided into:
   a. Physical environment and natural environment
   b. Natural environment and Man-made environment
   c. Man-made environment and social environment
   d. Social environment and Physical environment
5. The correct meaning of "Environmental Education" is:
   a. Educational process to cultivate awareness of environmental value
   b. Educational process to develop natural resources and environment
   c. Educational process to develop knowledge, understanding, and attitude towards the environment leading to practical action to preserve environmental quality.
   d. Educational process to cultivate a sense of recognizing environmental problems on the part of the public
6. The goal of "Environmental Education" is:
   a. Living organisms have harmony living with the environment
   b. Man can control the environment
   c. Struggle for existence of organisms
   d. Living organisms are not lost

7. The correct objective of "Environment Education" is:
    a. To be sensitive to the environment
    b. To be able to analyze environmental problems
    c. Up date on environmental events
    d. To create good attitude towards environment leading to participation in environmental problem- solving
8. Which is the principle of "Environmental Education"?
    a. Study of environmental issuers
    b. Study only students in the educational process
    c. Stress on local environment
    d. Promote students to recognize environmental value and be willing to participate in solving problems
9. "Mangrove" means:
    a. Forest that is full of all kinds of plants and animals
    b. Forest along sea beach, sea-shore
    c. Forest where tides reach
    d. Forest which marine waters flood over.
10. Mangrove ecosystem is what relationship?
    a. Plants and animals
    b. Plants and the mangrove environment
    c. Animals and the mangrove environment
    d. Plants, animals, and the mangrove environment
11. The optimum temperature for the healthy growth of mangroves is:
    a. Tropical where temperature falls 30-40 ^{0}C
    b. Tropical where temperature falls 25-30 ^{0}C
    c. Tropical where temperature falls 5-10 ^{0}C
    d. Tropical where temperature falls 10-20 ^{0}C
12. How does water affect the growth of plants in mangrove forests?
    a. Water must be salty
    b. Sea water must be tided up all the time
    c. Plants will grow well everywhere if sea water floods over them
    d. High tide – Low tide has the least effect to plants in mangrove forests

13. Important factors that affect the growth of plants in mangrove forests are:

a. Light intensity
b. Rain fall
c. Climate
d. High tide – Low tide of sea water

14. What is the special feature of plants in the mangrove forest?

a. Grow well either in fresh water or salt water
b. Plump stem, small leaves to reduce transpiration
c. No salt gland, because high resistance to mineral salts
d. Special root system for respiration

15. "Nypa Palm" in the mangrove forest is classified as:

a. Producer
b. First consurmer
c. Tertiary consumer
d. Decomposer

16. Which is the "first consumer"?

a. Squid, snail
b. Crab, shrimp
c. Dipaddy fish, crab
d. Snakehead mullet (prech, bass)

17. Which is the "decomposer" in the mangrove forest?

a. bacteria, mushroom, fungi
b. Plants and animals debris
c. snail
d. Plant root

18. Which is the correct "foodchain" in the mangrove ecosystem?

a. Plant – Shrimp – Crab
b. Plant – Snake – Mice
c. Plant – Crab – Bird
d. Plant – Bird – Crab

19. Transformation of energy in the mangrove ecosystem is not cyclical because:

a. It does not flows in the process as foodchain
b. In the transformation of energy, some energy will be lost
c. Sun light is the original step of transformation of energy
d. Potential energy is stored within the transformation of energy

20. Which is the major importance of mangroves to humans?

a. Major source of medicinal plants
b. The important source as a food producer
c. The important source of wood products
d. The important source of fuel

21. Which is the indirect advantage of mangroves to man?
    a. Use for fuel
    b. Use for home furniture
    c. Habitat for nursing marine animals
    d. Place to accumulate silt, muddy, musk and toxic buffer
22. Which is the factor most responsible for the destruction of mangroves?
    a. Unclear government policy
    b. Lack of co-operation from public
    c. Lack of support from upper lines
    d. Population explosion
23. What is the cause of mangrove deterioration in Samutprkarn ?
    a. The construction of industrial manufacturing plants
    b. Soil erosion of the sea-shore
    c. The construction of ports
    d. Shrimp farming
24. What is the effect of destroying mangroves?
    a. Increase in the area of shrimp farming
    b. Fishing and extinction of marine animals
    c. Decrease and extincition of marine animals
    d. Marine animals increase because of more open space
25. Which sectors should co-operate to protect and solve the deforestation of mangroves?
    a. Public
    b. Forestry officers
    c. Police
    d. Mangrove national resource committee
26. Which section of the mangrove area are people prohibited to take advantage of?
    a. Conservation area
    b. Economic Section A
    c. Economic Section B
    d. Reserved Forest Area
27. Which should not be practiced in mangrove conservation management?
    a. Control and concession of mangrove
    b. Public people are prohibited to take any advantage from the mangrove
    c. Reforestation for high product
    d. Protect and reserve mangroves for sustainable uses

28. Which is a long term effective way to conserve mangroves?
    a. Laws and legislation amendment
    b. Urgently specify the scale of protecting mangroves
    c. Promote and prepare the public for reforestation
    d. Continually promote the knowledge on conservation of mangroves to the public
29. Which is the appropriate way to prepare soil for planting mangrove plants?
    a. Use clay in the seedling bag
    b. Use muddy musk mixed with sandy soil
    c. Use muddy musk mixed with husk
    d. Use sandy soil mixed with husk
30. Which is the appropriate way for students to participate in mangrove conservation?
    a. Participate in mangrove protection planning
    b. Donate money to the mangrove reservation
    c. Join in mangrove protection committee
    d. Participate in mangrove reforestation and restoration if you have the chance

Part 2. Attitude Test on Mangrove Conservation

Explanation :

Consider the statements and tick ✓ in the prepared space with which you most agree

Meaning of 5 = most agree with
4 = agree
3 = less agree
2 = least agree
1 = not agree with

Statement	Level of opinion				
	5	4	3	2	1
1. EE is important for students only					
2. EE on mangrove is necessary for the public					
3. Mangrove is important to the ecosystem so we should join to conserve it					
4. Garbage in mangrove is useful to small marine animals					
5. Somchai is happy when his father bought him furniture made from Rhizophora root					
6. The mangrove reforestation should be the responsibility of the concession holder.					
7. The trainees should group together to make decisions on the management of mangrove and to solve problems					
8. Activities in mangroves are not interesting since they are full of dirty muddy musk and hot.					
9. Deforestation of mangrove decreases marine animals.					
10. We are hot and tired while reforesting mangroves at the Port but we are proud of our work.					

Part 3. Practical and Skills Test on Mangrove Conservation

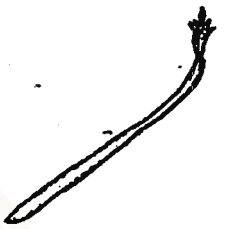
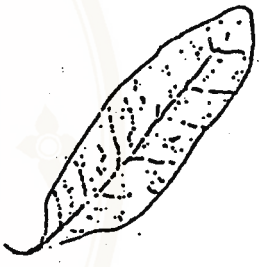
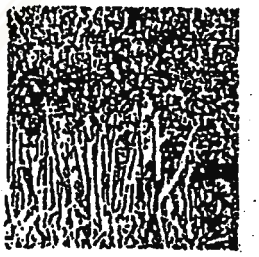
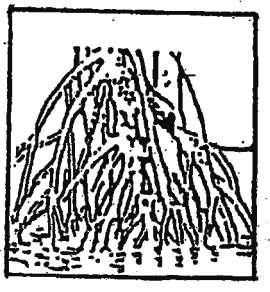
Explanation:

Answer the following questions concerning mangrove conservation participation:

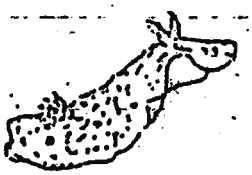
The physical features of the mangrove forest are found to be:

1. The site	☐	High tide – Low tide all the time
	☐	Flooding and tiding are not reached
	☐	Flooding over all the time
2. Soil characteristics	☐	Muddy musk
	☐	Sandy soil
	☐	Clay
3. Soil property	☐	Acid soil
	☐	Alkaline soil
	☐	Neutral soil
4. Climate	☐	25 – 30 ^{0}C
	☐	30 – 40 ^{0}C
	☐	20 – 25 ^{0}C
5. Light intensity	☐	Sunny
	☐	Cloudy
	☐	Shading
6. Wind	☐	Strong wind
	☐	Quiet (no wind)
	☐	Steady wind

Characteristics of Mangrove plants

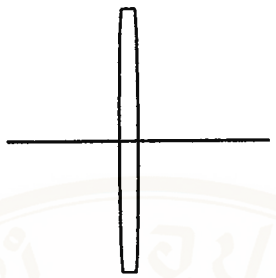
Part of tree	Make ✓ ☐		
7. *Avicennia* fruit	 ☐	 ☐	 ☐
8. *Derris* leaves	 ☐	 ☐	 ☐
9. *Nypa* stem	 ☐	 ☐	 ☐
10. *Rhizophora* root	 ☐	 ☐	 ☐

Characteristics of Animals in the Mangrove Forest

Part of body	Make ✓ ☐		
11. Birds in Mangrove Forest	 ☐	 ☐	 ☐
12. *Uca rosea*	 ☐	 ☐	 ☐
13. Lung fish *(Boleophtha-lums)*	 ☐	 ☐	 ☐
14. Naked Snail	 ☐	 ☐	 ☐
15. *Cerithidea cingulata*	 ☐	 ☐	 ☐

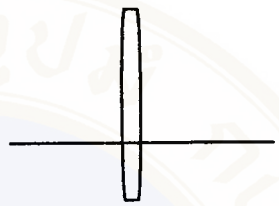
16. The correct method of Rhizophora plantation with pod

☐ ½ of pod



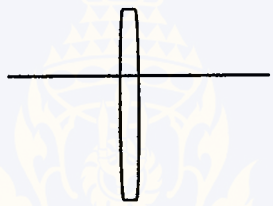
ground line

☐ 1/3 of pod



ground line

☐ ¼ of pod



ground line

17. Prepare soil for nursing plants

☐ Clay : Sandy soil = 1 : 1 ratio

☐ Muddy musk : Husk = 1 : 1 ratio

☐ Sandy soil : Husk = 1 : 1 ratio

18. The soil erosion nearby the Museum of the Mae-glong Gunship is caused from

☐ Digging water channel

☐ Cutting mangrove forest

☐ Storm wind

19. How can we solve this problem?

☐ Reforest mangrove, construct the sill barrier

☐ Construct silt barrier, reforest mangrove

☐ Construct the wall to dam the water, reforest mangrove

KEY OF TEST

Part I Knowledge Test

1. a	2. d	3. a	4. b	5. c
6. a	7. d	8. d	9. c	10. d
11. b	12 b	13 d	14. d	15. a
16. c	17. a	18. c	19. b	20. b
21. c	22. b	23. a	24. c	25. a
26. a	27. b	28. d	29. c	30. d

Part II Attitude Test

1. Negative	2. Positive
3. Positive	4. Negative
5. Negative	6. Negative
7. Positive	8. Negative
9. Positive	10. Positive

Part III Practice and Skills Test

1. a	2. a	3. a	4. a
5. b	6. a	7. a	8. a
9. b	10. b	11. a	12. b
13. b	14. a	15. b	16. b
17. b	18. b	19. b	

Evaluation of Training Curriculum on Mangrove Implementation

(For Trainers)

Please feel free to check your own choice

Evaluate issues	Level of opinion				
	Most	Much	Moderate	Less	Least
1. Appropriateness of curriculum aimed at knowledge, understand-ing, attitude and skills ; readiness to participate in restoration, conservation, and development of mangrove					
2. Coincidence of objectives and contents					
3. Appropriateness of theory content					
4. Appropriateness of practical content					
5. Appropriateness of training procedure					
6. Time requirement for theory part					
7. Time requirement for practical activities					
8. Appropriate of field studies					
9. Appropriateness of training lecture and discussion					
10. Appropriate of lecture room					
11. Appropriateness of learning stations					
12. Appropriate of materials and medias					
13. Appropriateness of handbooks and supplementary articles					
14. Appropriate of expert educators					
15. Appropriate of method of evaluation.					

Others suggestion.....

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Evaluation of Training Curriculum on Mangrove Implementation

(For Trainees)

Please feel free to check on own choice

Evaluate issues	Level of opinion				
	Most	Much	Moderate	Less	Least
1. Appropriateness of Theory content					
2. Appropriateness of practical activities					
3. Appropriateness of training process and procedure					
4. Appropriateness of time for theory					
5. Appropriateness of time for activities					
6. Appropriateness of expert educators					
7. Appropriateness of training room					
8. Appropriateness of practical sites					
9. Appropriateness of materials and medias					
10. Appropriateness of supplementary articles					
11. Appropriate of training facilities					
12. Appropriateness of knowledge attained					
13. Appropriateness of field studies					
14. Appropriateness of time requirement for training					
15. Appropriateness of food and drink service					

Others suggestion.....

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Observation and Group Behavior Evaluation

(for Expert Educators)

Learning Station / Activity.....

Name of Expert.....

Observe group behavior of the trainees during their practical practices, and check your choice

Where 4 = very good
3 = good
2 = fair
1 = needs improvement

Observation lists	Evaluation				Remark
	4	3	2	1	
					Group...
1. Activities planning					
2. Following practical steps					
3. Group co-operation					
4. Discussion and questioning					
5. On time practices					
6. Giving hand in – hand co – operation					
7. Intention to practice					
8. Interested in practices with enthusiastic manner					
					Group...
1. Activities planning					
2. Following practical steps					
3. Group co-operation					
4. Discussion and questioning					
5. On time practices					
6. Giving hand in – hand co – operation					
7. Intention to practice					
8. Interested in practices with enthusiastic manner					

Project Name: Communication and Youth Campaign on Conservation of Mangrove

1. Principle and rationale

The mangrove forest is a unique plant community in saline, tidal muddy musk along sea-coast, river mouths, channels, and islands. Rhizophora is the dominant group of economic importance. Mangrove provide plenty of nourishing foods for young marine animals and good shelter to protect them from wind and waves. A diversity of marine lives can be found in the mangrove, such as plankton, shrimps, mollusks, crabs, and fish. Mangrove is not only a place for study and research, but also a recreation area for tourists.

Due to the economic importance of mangroves, man has increasingly invaded, deforested, and deteriorated the mangrove forest even though the government canceled the concession of mangrove forest in 1996. Mangrove deforestation has continued to the point that the National Economic and Social Office declared that Thailand should have mangrove areas of no less than 1.05 million Rai by the end of 2001

An effective way to solve the mangrove problem and promote the sustainable restoration of mangrove forests is to cultivate the awareness and the sense of responsibility and partnership between the students in schools and the public. Training each member of the public can break down barriers and build relationships. Therefore developing a training curriculum of EE on mangroves for lower secondary grade school students and experimenting to implement the training curriculum is an urgent issue.

The Office of Provincial General Education with the co-operative effort of the local fishery unit and local forestry unit along with Saklasutira upatum School has organized a training program for lower secondary school students to cultivate their sense of awareness, responsibility, and conservation of mangroves in Samutprakarn province.

2. Objectives

1. Students learn to recognize the mangrove problems
2. Students develop a good attitude towards conservation of mangroves
3. Students gain practical skills to conserve, restore, and develop mangrove areas

3. Goal

Quantity : Training 60 students

Quality : Students learn basic knowledge, understanding and awareness of mangrove conservation.

4. Training site

4.1 Saklasutira-upatum School

4.2 Port of Chulchomkloa, Bangkok Navy Base

5. Time schedule

17 – 18 June, 1999

6. Process and procedure

6.1 Propose the training program

6.2 Assigned committee, meeting and preparation

6.3 Co-ordinate work force, sites, and supplementary articles

6.4 Training in process

6.5 Trainees follow-up

6.6 Conclusion

7. Contents

7.1 Basic knowledge on the environment

7.2 Mangrove ecosystem

7.3 Mangrove situation

7.4 Mangrove conservation and mangrove restoration

7.6 Mangrove plantation

8. Cost

Funding support from the Office of Environmental Policy and Planning: 56,400 Baht

9. Responsible sectors

9.1 Office of Local General Education

9.2 Local Forestry unit

9.3 Local Fishery unit

10. Related sectors

10.1 Bangpleerajbumrung school

10.2 Saklasutira – upatum School

10.3 Secondary Schools in Samutprakarn

10.4 Board of Sakla district

10.5 Port of Chulchomkloa, Bangkok Navy Base

10.6 Kasertsart University

10.7 Mahidol University

10.8 Srinakarinwirot University

10.9 Lam Fa-Pa District Public Health

10.10 Pra-Samutjedee District Public Health

11. Evaluation and Follow – up

11.1 Pre-test and Post-test

11.2 Training Evaluation

11.3 Practical work observation

12. Expected Outcome

12.1 Students gain conceptual recognition of mangrove conservation

12.2 Documentary and resource for training curriculum for local implementation

13. Co-ordinators

13.1 Santi Sungtong Samutprakarn Fishery Unit

13.2 Greinggrai Boonlean Samutprakarn Forestry Unit

13.3 Suri Keawses Office Local General Education

13.4 Prarop Kaoses Bangplee rajbumrong School

BIOGRAPHY

NAME Mr. Prarop Kaoses

DATE OF BIRTH 31 January 1948

PLACE OF BIRTH Pattalung Thailand

INSTITUTION ATTENDED Srinakarinwirot University, 1974 – 1977 :
Bachelor of Education (Biology)
Mahidol University, 1983 – 1986
Master of Education (Environmental Education)
Mahidol University, 1996 – 2001
Doctor of Education (Environmental Education)

RESEARCH GRANT Research for Thesis Grant, Provincial Forestry Office and Provincial Fishery Office.

POSITION & OFFICE 1997 – Present, Bangpleerajbumrong School
Samutprakarn, Thailand.
Position : Lecturer