A PROPOSED BIOLOGY TEACHER TRAINING PROGRAM FOR SECONDARY SCHOOL TEACHERS IN THE MEKONG DELTA REGION OF VIETNAM

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This is to certify that the

thesis entitled

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ABSTRACT

A PROPOSED BIOLOGY TEACHER TRAINING PROGRAM
FOR SECONDARY SCHOOL TEACHERS IN THE
MEKONG DELTA REGION OF VIETNAM

By

Phung Thi Nguyet Hong

This study was undertaken to design a biology training program for secondary school teachers (grades six to twelve) in the Mekong Delta region of Vietnam, with the major emphasis on the construction of courses and experiences within the biological sciences.

The methods reported in this study consisted of the following processes: First, an analysis was made of the current biology training programs at Cantho University, with reference to a new set of Vietnam school biology objectives developed in the 1970 curriculum revision. The revision was made in response to new developments in biology education, and called for changes both in content and teaching methods, resulting in a demand for a different pattern of teacher training. Second, a review of the modern developments in biology education and training programs in the United States suggested guidelines for planning a curriculum that would have a "modern" characteristic both in content and in instructional methods. Third, an analysis

of the socio-economic aspects of the Mekong Delta region was made, to determine the needs and demands upon which planning should be concentrated so that the selected biology knowledge would have a direct application to the immediate environment. Public health, agriculture, and fisheries were chosen as areas of emphasis for the organization of the major course content and experiences.

The criteria for planning an effective biology training program involved the following parameters: (1) The training should be a four-year program; (2) Biology teachers should have a broad minimum competency in related sciences; and (3) Teachers should have sufficient training in their major area to provide an understanding of the nature of the discipline, its substance, and its methods.

From the preceding analysis and criteria, the biology program was formulated and included three components:

Biology	40-45 semester credits
Related Sciences	36-37 semester credits
Other Program Components	58-64 semester credits

The biology program consists of two units: Introductory Biology and Advanced Biology. The Introductory Biology program provides breadth of biological sciences with modern concepts according to recent discoveries. Advanced Biology gives depth on topics organized under three selected areas of concentration: public health, agriculture, and fisheries. The proposed program includes the major topics for each unit; a devised laboratory approach is also described.

Recommendations for implementing the proposed program were classified into four categories: recommendations on location, on instructional materials, on staff formation, and on administration. Problems for further research were also suggested.

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By

Phung Thi Nguyet Hong

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Kính Tặng

BA MÁ, các ANH CHI, MINH và các CHÁU,

Sư hy-sinh, khuyến-khích và an ủi dã

dóng góp vào thành quả nầy.

Dedicated to

Professor Nguyen duy Xuan, who inspires me, and

Dr. Tran phuoc Duong, who gives me faith and encouragement.

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STATEMENT OF THE PROBLEM

Introduction

The fundamental problem to be treated here is the construction of a biology teacher training curriculum for the Mekong Delta region of South Vietnam. Major emphasis is placed on the organization of courses and experiences within the biological sciences, with less emphasis on strictly pedagogical instruction.

This study reviews biology teaching and the training programs for biology teachers in Vietnam; trends in biology curriculum development at the high school and college levels in the United States and in South East Asia; and the unique needs of the Mekong Delta region. The formulation of a locally based teacher training program is generated on the basis of the analysis of these findings.

Background of the Study

Education, including higher education, is held in high regard by the Vietnamese society. In fact, tremendous increases in enrollments at all levels are apparent throughout South East Asia. Based on the rising expectation that education is the most effective way to approach a better life, both socially and economically, there is a very real "thirst for education"[1] among the people. Furthermore, if the country as a whole is to realize its productive potential, widespread educational opportunity seems a necessity. Nguyen quang Quynh said: ". . . The strengthening of the productive power of the people greatly depends on the educational and cultural standard of the masses."[2]

The importance of education as an agent of change in a developing nation is recognized everywhere.[3] And in a war-torn country like Vietnam, education assumes an even more important role in shaping the future. Philip Coombs noted that ". . . A society can only achieve sustained economic growth and build viable social and political institutions if it invests adequately and early in the development of its people's talent."[4]

In addition, all of modern society is becoming increasingly dependent upon science. There seems to be no doubt of the value of science and its impact on social and economic development, and the awareness of this importance has been recognized in school programs all over the world.

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[1]Virginia Thompson, French Indochina (London: George Allen and Union, Ltd., 1937), p. 286; see also "Forging a New System of Education in Vietnam," Vietnam Feature Service, Pub. 016 (Washington, D.C.: AID, n.d.), pp. 1-17. (Mimeographed.)

[2]Nguyen quang Quynh, "Education in Underdeveloped Countries," Asian Culture, III, 1 (January-March, 1961), 85.

[3]Philip H. Coombs, "Education's Role in the Developing Nations," Saturday Review, August 17, 1963, p. 29.

[4]Ibid.

Securing scientific knowledge and experience is largely dependent upon the competency of science teachers and the science materials used in the developing country. Consequently, teachers apparently play a key role in the process of change. Beeby spoke directly to this relationship when he said, "It is only through them [the teachers] that it can be reformed."[1] In other words, to improve science instruction in the schools, it is necessary to improve the program by which science teachers are prepared.

Need for the Study

In 1964, the first National Education Convention was called in Vietnam. The participants included educators and representatives of the general population, who discussed possible directions for a national educational policy. The most significant recommendation to come from the Convention was the establishment of a curriculum differentiated according to the needs of the four geographical regions of the country.[2] As a result, four separate types of curricula were suggested for the city, delta, highland, and coastal areas. The development of this new educational structure was not realized until 1966. At that time, Cantho University was founded in the Mekong Delta region and represented a new

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[1] C. B. Beeby, The Quality of Education in Developing Countries (Cambridge: Harvard University Press, 1966), p. 37.

[2] UNESCO, "Education Development in 1964-1965," International Yearbook of Education, XXVII (1965), 399-403.

thrust in Vietnamese higher education in response to the people's aspirations for the development of their local region.

The university began work on its curriculum at once. At the beginning, primarily because of a lack of teaching staff, the university was unable to carry out the specific function of producing a local program, even though the mandate clearly allowed that: "Subjects of regional characteristics may be taught to local students in addition to ordinary subjects, for example history may be specially taught in Hue and agriculture in Cantho."[1]

Instead, the new university duplicated the same curricula as other state-financed universities. Recently, its specific function was re-emphasized by the Rector on the occasion of the first graduation ceremony as follows: "Cantho University was established in respect to the aspiration of people living in this region. Therefore, it must serve its people and improve its community."[2]

There has been actual progress in the biology curriculum during the past academic year. For example, a course in Ichthyology[3] for biology majors has been added

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[1]"Arts Colleges to Adapt New Curriculum," Vietnam Bulletin, III, 53 (October 1-15, 1969), 9.

[2]Nguyen duy Xuan, "Speech Given on the First Graduation Ceremony at Cantho University," Dat Nhan, No. 2 (February, 1971), 5.

[3]University of Cantho, Handbook of the Faculty of Science, 1971-1972, pp. 10-11.

because the fishing industry ranks second in importance among products of the Mekong Delta region. Nevertheless, the training program for biology teachers, which was not being given much consideration, has received almost no efforts toward the goal of serving the local region.

Thus, the present study is designed to suggest a pattern of teacher training in biology for quality to meet the needs and demands of the Mekong Delta region.

Related Studies

Although designed for a particular region of Vietnam, this study is part of a larger multiple effort which has been conducted in Vietnam and abroad and has involved both short- and long-term training programs in cooperation with several agencies. Through these training programs, there has been a concerted attempt to increase the effectiveness of science curriculum in schools and in colleges. The Ohio University Contract Team, for example, has worked in close cooperation with the secondary schools and the training centers in Vietnam in an effort to assist in the utilization of the science laboratory and instructional media.[1]

The literature pertinent to this study includes the following research:

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[1]"Ohio University Contract, USAID/EDUCATION, Semi-Annual Report" (Washington, D.C.: USAID Education Division, Teacher Training). (Mimeographed.)

1. "Suggested Activities to Teach Biology in Vietnamese High Schools,"[1] in respect to teaching methods of inquiry developed by the Biological Science Curriculum Study Project.

2. "Strategies for Improving Science Education Practices in Vietnamese Secondary Schools,"[2] which proposed different techniques for modifying the science teaching in secondary schools.

3. "A Macro-Design of an Operational Model for the Development of the Chemistry Program in Vietnam: Implication for Chemistry Education in Vietnamese Secondary Schools and for the Pre-Service Education of Propsective Physics and Chemistry Teachers in Vietnam,"[3] which developed a chemistry program for senior high schools and a proposed training pattern to cope with the new program.

4. "A Proposed Core Curriculum for the First Two Undergraduate Years,"[4] designed as a model of general

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[1]Ngo ngoc Anh, "Suggested Activities to Teach Biology in Vietnamese High Schools" (unpublished M.A. thesis, The Ohio State University, 1970).

[2]Nguyen thi Du, "Strategies for Improving Science Education Practices in Vietnamese Secondary Schools" (unpublished M.A. thesis, Michigan State University, 1971).

[3]Hua vang Loc, "A Macro-Design of an Operational Model for the Development of the Chemistry Program in Vietnam: Implication for Chemistry Education in Vietnamese Secondary Schools and for the Pre-Service Education of Prospective Physics and Chemistry Teachers in Vietnam" (unpublished Ph.D. thesis, Michigan State University, 1972).

[4]Nguyen van Thuy, "Proposal for a Model Core Curriculum for the First Two Undergraduate Years in Institutions of Higher Education in Vietnam" (unpublished Ph.D. thesis, Michigan State University, 1971).

education in providing basic knowledge and guidance preparation necessary before starting vocational and professional skills.

5. "Proposal for a Model Program of Science Teacher Education in Vietnam,"[1] which was concerned with the general and professional education for prospective teachers who assume the task of modern science teaching in Vietnamese secondary schools.

Scope of the Study

The development of a biology teacher training program raises the following questions:

1. What are the content objectives of biology teaching in Vietnamese secondary schools?
2. How well are the present teaching practices and the teacher training programs in biology meeting the current objectives of biology teaching in Vietnamese secondary schools? What changes are needed?
3. In light of the local natural resources, geographical location, and socio-economic structure, what types of biological concepts should be developed in the training program for secondary school biology teachers in the Mekong Delta region?

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[1]Phan My Linh, "Proposal for a Model Program of Science Teacher Education in Vietnam" (unpublished Ph.D. thesis, Michigan State University, 1971).

4. What do modern trends in international biology education suggest for the teacher training program?
5. Finally, what criteria have been developed in previous studies to evaluate training programs for prospective biology teachers?

Procedures and Sources of Data

Because of the insecurity of a war-time country and the unstable and expensive mail service to Vietnam, this study is entirely descriptive in nature and is basically documentary research, which was conducted through the use of the following sources:

In Vietnam:

- At the Ministry of Education: school programs, syllabi, textbooks, research publications, and census and statistical information.

- At Cantho University: The University Handbook and the University magazine, Dat Nhan.

- At the National Geography Institute: geographical data.

In Southeast Asia:

Reports of the Asian Association for Biology Education (AABE) and of the South East Asia Ministers of Education Organization (SEAMEO) regarding the regional efforts to improve school biology and the training of teachers.

In the United States:

- Research studies and reports published by the United States Agency for International Development (AID), Mission to Vietnam, Saigon.

- Publications of the United Nations Educational, Scientific and Cultural Organization (UNESCO).

- Publications of the Food and Agricultural Organization (FAO).

- Publications of the Educational Research Information Center (ERIC).

- Finally, biology textbooks, materials, pamphlets, reports of regional and national conferences, and related literature pertaining to the research topic.

Limitations of the Study

The pre-service teaching training program assumes two major components: academic requirements and professional education.

It is not within the scope of this study to deal with professional education, which is the topic of the My Linh study previously cited. Nevertheless, a methods course of teaching a specific field, in this case biology, is suggested as a result of the effective teaching and learning of modern biology.

In terms of the geographical area, this study is basically designed for the Mekong Delta region in regard to the emphasis given to a training program which is locally significant in that particular region.

Definition of Terms

To convey connotations used throughout this study, several terms are defined as follows:

Mekong Delta region--A portion of the Delta lying within Vietnam and considered to comprise sixteen southern provinces or roughly the area lying south of West Vam Co River.[1] Its soil, regularly enriched by the Mekong alluvium, is drained by the Mekong River. The attached map illustrates the description and boundaries of its enclosed provinces (see Figure 1).

Secondary school--Any institution in which the program of instruction is from grade 6 to grade 12.

Secondary school teachers--Those who teach in secondary schools (grade 6 to grade 12).

Overview

In Chapter II, the origin of the school biology program and current practice in light of the objectives of secondary school biology teaching are discussed. Likewise, teacher training programs are explored, with special reference to the biology training programs at Cantho University.

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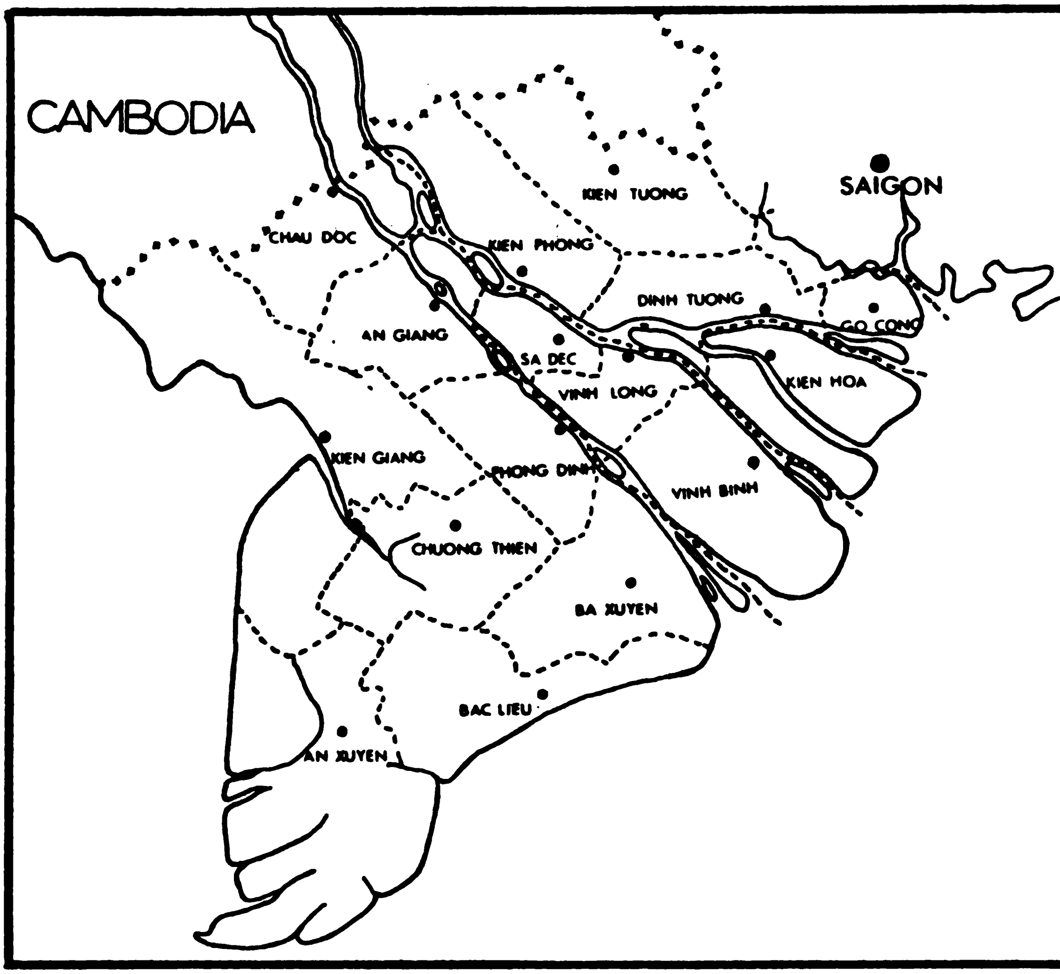
[1]Republic of Vietnam, *Mekong Delta Development Program* (New York: Development and Resources Corporation, 1969), pp. 1-11.

THE MEKONG DELTA REGION
PROVINCES



Source: Republic of Vietnam, <u>Map of Vietnam</u> (Dalat: National Geography Institute, 1966).

Figure 1.--The Mekong Delta region provinces.

In Chapter III, a survey of the socio-economic aspects and natural resources of the region is used to determine emphases to be considered in developing the training program.

Chapter IV contains a review of trends in biological education regarding content and methodology at both schools and colleges in the United States, and their implications for Southeast Asia.

Taking into account the findings in Chapter III and the current trends in biological education, in Chapter V the proposed program is formulated with regard to suggested criteria of an effective training program in biology.

In Chapter VI, conclusions of the study and recommendations for implementation of the proposed program based on the findings of the preceding chapters are set forth.

CHAPTER II

THE STATUS OF BIOLOGY TEACHING AND THE TRAINING OF BIOLOGY TEACHERS

Background

The possession of a transistor radio and the efficacy of modern medicaments have already been experienced by most people, even those in the smallest villages of Vietnam. That simply indicates their familiarity with modern technology. People are becoming aware of technological advances, but most are only vaguely conscious that science has something to do with all this. An understanding of the principles and theories of science which underlie these developments is basically communicated through the educational institutions of the societies. These institutions, therefore, determine the degree of scientific literacy of the citizenry. In Vietnam, the teaching of science subjects is of fairly recent origin in the school system. It began when the fundamentally Western-based division into grade levels and the distribution of learning experiences in each grade was imposed, near the end of the nineteenth century, upon the traditional system of education.

Previously, education had been patterned after the Confucian-dominated system, which was exclusively a literate program based upon the idea that moral principles and virtues[1] shaped a person's mind. Classics and the ethical principles of the ancient sages of China were regarded as perfect and final;[2] other contemporary worlds and their various cultures, as well as other realms of knowledge, were disregarded. Uniform programs and textbooks were used by all, regardless of their age, abilities, and interests.[3] However, it is worth noting that there were very few illiterates under this traditional system of education.[4]

A modern educational system came along with colonization, and was forced to replace the traditional one. Education was regarded as an effective tool to exploit the natural resources of the colony, but neither to open the minds of its people to a new world nor to convey notable concepts of science. As a matter of fact, any educational effort was confined to that which allowed better communication between the natives and the French. This policy produced an extremely high rate of illiteracy among the population.

Massive efforts during recent decades have been made to meet the rapid rise in school enrollments. The

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[1]Pike N. Edgar, "Public and Private Education in Vietnam," Asian Culture, II, 2 (June, 1960), 80.

[2]Vu Tam Ich, "A Historical Survey of Educational Development in Vietnam," Bulletin of the Bureau of School Service, XXXII, 2 (December, 1959), 28.

[3]For programs and textbooks under the traditional education system, see Vu Tam Ich, Ibid., pp. 33-36.

[4]Pierre Pasquier, L'Annam d'Autrefois' (Paris: Societe d'Editions Geographiques, 1930), p. 166.

demand for more available schooling is at a critical level. In spite of this, we must not take only a quantitative view, but also consider the quality of teaching and learning. Both should progress concurrently for any desirable solution to the problem of the development of an educational system.

The purpose of this chapter is to analyze the present status of biology teaching in the secondary schools and the training of biology teachers for secondary education. An attempt is made to determine the strengths and weaknesses of the situation, with major emphasis on the needs in the training courses in biology.

Biology Teaching in Vietnamese Secondary Schools

This section is intended to explore the developmental background of biology teaching in Vietnamese secondary schools. The section is subdivided into phases, based upon decisive modifications in the educational system of the country: Phase 1--Biology teaching under French control and Phase II--Biology in national education.

Phase I: Biology Teaching Under French Control

After the successful conquest of South Vietnam with superior armed forces in 1861, the French needed to establish a colonial administrative system. They had acquired, in South Vietnam, one of the world's richest rice reservoirs, a country already well organized by the

Chinese,[1] and headquarters for further military expeditions toward the northern regions. The first occupation troops were faced with an immediate lack of understanding. The country and its people were unfamiliar with white men and the French language, just as the French were unacquainted with the Vietnamese. Though it is obvious that the expansion of Western education was not the primary ambition of the invaders, education became a vital concern and the sole instrument capable of resolving the communication problem. A College of Interpreters was opened immediately in 1861.[2] The first public education system was soon initiated and science subjects were taught to convey the basic rules of hygiene.[3] Naturally, French was the medium of instruction; therefore, some schools were opened in 1869 to teach Vietnamese adults the rudiments of French.[4] The following statement expresses the educational policy of the French at the beginning:

> Most authorities agreed that education in Indochina was diffuse and anarchic concentrating on providing native auxiliaries to the administration with some notion of French.[5]

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[1]Thompson, op. cit., p. 61.

[2]Joane Marie Coyle, "Indochinese Administration and Education: French Policy and Practice" (unpublished Ph.D. dissertation, Fletcher School of Law and Diplomacy, Tufts University, 1963), p. 47.

[3]Thompson, op. cit., p. 300.

[4]Coyle, op. cit., p. 47.

[5]Ibid., p. 53.

Such an educational goal was not likely to be popular with the Vietnamese, so it was rarely admitted. The high drop-out rate at the primary level and political unrest were given as reasons for not providing a secondary education for the natives.[1] Of course, if they knew their French and little else they could be more easily controlled. In the orders given to the new Governor General Klobukowsky,[2] France stressed "the need for more primary and professional instruction and pointed definitely away from secondary education on the ground that Vietnamese were not prepared for it."[3]

Public secondary education for the natives was nonexistent at that time; however, to serve the French population the first high school or more exactly the junior high school--the College Indigene--was established in 1875.[4] Designed primarily for French children, its curricula were identical to the metropole schools in France. Beseiged by ambitious students, the college was eventually opened to a few natives.

It was not until 1906 that the first important modification in curriculum took place. The Council of the Local

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[1] Ibid., p. 64.

[2] Governor General from September, 1908 to January, 1910, according to Joseph Buttinger, The Small Dragon (New York: Frederic A. Praeger, 1958), p. 428.

[3] Thompson, op. cit., p. 290.

[4] Edgar, op. cit., p. 84.

Committee of Perfection of Native Education attempted to review the curricula, set standards, and make recommendations. This Council agreed to add Western science to the curricula[1] because the natives were loudly demanding it after the Japanese victory over the Russians in 1905. Finally, the first secondary education for the natives was created in 1912 with the junior level (Enseignement Complementaire Franco-Indigene) and in 1917, the senior high (Enseignement Secondaire Locale) was established.[2] Hence, a coherent system of modern education for the natives was not fully instituted until 1918. After that, a parallel education system of French education (for French children in priority) and Franco-Vietnamese education (exclusively for the natives) was operated concurrently. The latter paid scant attention to the traditional Vietnamese culture, so it was almost like the former in its curriculum.[3] The <u>Arretes du 26 December 1924</u> promulgated the first universal program of secondary education for the natives (Tables 1 and 2). It was comprised of two levels: the junior level of four years (Enseignement Primaire Superieure Franco-Indigene)

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[1]Le Thuoc, "L'Enseignement des Characteres Chinois," <u>Revue Indochinois</u>, July-August, 1921, p. 109. See also Thompson, <u>op. cit</u>., p. 288.

[2]August Rivoalen, "L'Oeuvre Francaise d'Enseignement au Vietnam," <u>France Asie</u>, XIII, 125-126-127 (1956), 405.

[3]Thompson, <u>op. cit</u>., p. 287.

Table 1.--Program of study in junior high school of Franco-Vietnamese system (per hour per week).

Subjects	Boys Year 1st	2nd	3rd	4th	Girls Year 1st	2nd	3rd	4th
French	9	9	9	9	9	9	9	9
Morals	2	2	2	2	2	2	2	2
History	2	2	1	1	$1\frac{1}{2}$	$1\frac{1}{2}$	1	1
Geography	1	1	2	2	1	1	$1\frac{1}{2}$	$1\frac{1}{2}$
Vietnamese language	3	3	3	3	3	3	3	3
Mathematics	3	3	3	3	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
Geometric drawing	1	1	1	1	0	0	0	0
Physics & chemistry	2	2	3	3	2	2	$2\frac{1}{2}$	$2\frac{1}{2}$
Natural sciences and hygiene	2	2	1	1	$1\frac{1}{2}$	$1\frac{1}{2}$	1	1
Arts	3	3	3	3	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
Home economics	0	0	0	0	5	5	5	5
Physical education	2	2	2	2	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

Source: Gouvernement General de l'Indochine, Direction de l'Instruction Publique, Arretes du 26 December 1924 (Hanoi: Imprimerie d'Extreme Orient, 1924), p. 4.

Table 2.--Program of study in senior high school of Franco-Vietnamese system (per hour per week).

Subjects	1st Year	2nd Year
French	7	6
Philosophy	2	3
History and geography	3	3
Mathematics	4	4
Geometric drawing	1-1/2	1-1/2
Physics and chemistry	4	4
Laboratory	1	1
Natural sciences	2	2
Chinese	1	1
Arts	1-1/2	1-1/2
Physical education	2	2

Source: Gouvernement General de l'Indochine, Direction de l'Instruction Publique, Arretes du 26 December 1924 (Hanoi: Imprimerie d'Extreme Orient, 1924), p. 52.

and the senior level of two years (Enseignement Secondaire Franco-Indigene).[1]

Western science teaching was making its way into the curriculum of the Franco-Vietnamese system and such subjects as mathematics, physics, chimistry, and natural sciences were included in response to the natives' demand for modern science courses and the demand of powerful investments for trained manpower in agriculture, industry, and commerce in the colony.[2] As a matter of fact, both scientific and economic aspects were in evidence in the biology teaching program. According to the instructional directions, biology teaching had a practical purpose which concentrated on acquainting the natives not only with plants and animals found in their environment, but also with those of beneficial and detrimental values. This economic aspect of biology teaching in secondary schools of the Franco-Vietnamese system likely reflected the actual status of biology teaching in Western countries,[3] and was largely in harmony with the colonial policy of the French in Indochina. Thus, if one

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[1] Gouvernement General de l'Indochine, Direction de l'Instruction Publique, Arretes du 26 December 1924 (Hanoi: Imprimerie d'Extreme Orient, 1924), p. 4.

[2] "Enseignement Superieur Secondaire," Asie Francaise, January-April, 1918, p. 29.

[3] O. W. Richards, "The Present Content of Biology in Secondary Schools," School Review, XXXI (February, 1923), 43-36; Charles William Finley, Biology in Secondary Schools and the Training of Biology Teachers (New York: Teachers College, Columbia University, 1926), pp. 1-16.

speaks in terms of the progress of biology teaching in relation to the Western countries, the implemented goals were not much out of step.

The content at the junior level included classification and physiology as the main topics. Emphasis was given to classification of the animal and plant worlds on the basis of their external characteristics. Local representations of animals and plants of economic importance were mentioned. Few notions of agriculture were given consideration, even though Vietnam had an agriculture-dependent economy. The description of anatomical structures of organs and of functions was given in order to understand simple mechanical movements and physiological phenomena in the human body. Some widespread contagious diseases were given attention also.

Biology teaching at the senior level resumed the teaching of anatomy and physiology of plants and animals, and included more details at the descriptive level. Again, some applications for agriculture were included. Study of the evolution of living things and of microbes and their importance in industry and agriculture and as the causative agents of infectious diseases were additions worth mentioning.[1] Instructional materials were scarce, and consisted almost exclusively of a few biology texts written in French, since French was the only foreign language understood.[2]

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[1]Arretes du 26 December 1924, op. cit., pp. 38-42, 78-82.

[2]Thompson, op. cit., p. 284.

The teaching methodology was primarily based on observation techniques. Equipment was no doubt very limited and scarce. The practice of dissecting and making careful drawings was carried out as the means of observation and illustration of whatever was published in the reading texts.

Learning experiences were evenly spread in interdisciplinary sequences with other science subjects such as mathematics, chemistry, and physics in each grade throughout secondary schooling. Such an arrangement, if well-organized, can greatly benefit the mutual understanding of the various disciplines. Physics and chemistry, for example, can help one understand the physiological phenomena. Mathematics can contribute to an understanding of parametric measures in biology. Poorly organized, this scheme merely lengthens and splits the biology course into separate pieces of knowledge. In such a situation, the nature of biology teaching can become largely dependent on the rote learning of numerous structural terms and latinized names, with little emphasis on the related science subjects.

In summary, the Vietnamese adopted the biology teaching pattern of Western countries at that time. The first biology programs for the secondary schools in Vietnam were descriptive and taxonomic. Finley described the teaching methods of the day as ". . . memorization to be held as a direct outcome of the systematic study of the subject and the careful laboratory work with its attendant notes and drawing."[1]

Legally laid down in 1924, these programs of study remained functional until 1945, without any significant modifications.

Phase II--Biology Teaching in National Education

The beginning of this period was marked by an important change in the political setting, which was the first achievement of independence.[2] A very important modification in education was carried out in the 1945 educational reform. At that time, the Vietnamese language was substituted for French at all levels of the elementary and secondary schools.[3] That action, more than any other, signified the beginnings of a national education program.

Educational reform was effected earlier in the north and central parts of Vietnam.[4] It was not until 1949 that several governmental decrees proclaimed the organization of the national education program as well as the curricula of secondary education and all regions actually changed.[5] Education objectives were first defined on the basis of three

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[1] Finley, *op. cit.*, p. 4.

[2] For more details, see Vu Tam Ich, *op. cit.*, Chapter X.

[3] *Ibid.*, p. 103.

[4] UNESCO, *World Survey of Education*, Vol. III: *Secondary Education* (New York: UNESCO Publications Center, 1961), p. 1454.

[5] *Ibid.*

principles: Dan-toc, Khoa-hoc, Dai-chung (national, scientific, popular),[1] emphasizing science and mathematics. However, no revolutionary change was actually made in the classroom, since the school system and the program of studies were still basically patterned after the French.[2]

It was not until later, in 1953,[3] that a reorganization of the structure and goals of secondary education was undertaken. The new structure was designed around two cycles. The first cycle, of four years' duration, was planned to provide essential knowledge for those whose schooling would be terminal. The second cycle, of three years' duration, was designed to provide specialized education[4] and serve as a preparatory stage for college-bound students. The educational objectives of the system twice were successively redefined, in which processes the third principle was changed from "popular" to "humanistic." The existing educational objectives endorsed by the Constitution consist of three principles: Nhan-loai, Dan-toc, Khoa-hoc (humanistic, national, scientific).

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[1] Duong Thieu Tong, "A Proposal for the Comprehensive Secondary School Curriculum in Vietnam" (unpublished Ph.D. dissertation, Teachers College, Columbia University, 1968), p. 32.

[2] Vu Tam Ich, *op. cit.*, p. 103.

[3] *World Survey of Education*, *op. cit.*, p. 1454.

[4] D. C. Lavergne and Abul H. K. Sassani, *Education in Vietnam* (Washington, D.C.: U.S. Department of Health, Education and Welfare, Office of Education, Division of International Education, 1955), p. 11.

Recently, a movement took place to realign the educational structure throughout the grades. Secondary education was changed in form from a 6-12 plan, but its goals remain the same as those stated in 1953. It still provides general education in grades six through nine and a specialized education in grades ten through twelve.

Changes in educational organization and/or structure have brought about a revision in the curriculum. Consequently, secondary school biology has undergone two major reforms--in 1964 and 1970. Attempts have been made to update the curriculum in the face of the explosion of scientific knowledge, and to implement a laboratory program in biology in the secondary schools, since the "natural sciences are experimental sciences founded on observation and practical experiments."[1]

The Syllabus of 1970 indicates that the objectives and the content of biology for secondary education are as follows:

The general objectives are

- to provide essential knowledge of the living world,
- to observe and to think scientifically, and
- to encourage the application of learning experiences into routine living.

Teaching methodology should move

- to delete the memorization methods,

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[1]Republic of Vietnam, Ministry of Education, <u>Secondary Education Curriculum</u>, 1966, p. 64.

- to illustrate lectures with charts, models, or experiments,
- to stimulate the students' participation in discussions and to maximize practice of laboratory work, and
- to require teachers to up-date instruction with scientific discoveries.

The program of study for the first two grades concentrates on the diversity of plants and animals in regard to their habitats and living habits.

In the ninth grade, emphasis is given to a study of the structures and functions of different organs in the human body, along with hygiene. Early specialization takes place at the senior high level, and a student chooses to major either in natural sciences, mathematics, or literature. The biology program provides a continuation of the study of plants (with such topics as anatomy, nutrition, reproduction, plants and environment, and Pasteur's work) and of animals (with special consideration of anatomy and physiology, reproduction, and heredity). This material is the core of the eleventh and twelfth grade program for the natural sciences major, and the two other majors are given summary notions on fewer topics.[1] Compared to the original Franco-Vietnamese program, there have been remarkable changes in the stated objectives and recommended methodology. Content

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[1] For more details, see Republic of Vietnam, Ministry of Education, Secondary Education Curriculum, 1970, pp. 140-163.

reform has been executed by eliminating some obsolete principles and by adding more advanced ideas to the program. For example, in the Syllabus of 1970, information on DNA and RNA is introduced in grade twelve; the topic "Plants and Their Environment," which had been treated as an advanced course in the undergraduate program is now partially implemented in grade eleven. An analysis of the instructional texts in use reveals that they primarily follow the old curriculum and contain all the shortcomings associated with a traditional biology course. For example:

1. Biology is presented as a body of knowledge, verified and certain, and as a list of isolated facts and basic principles, without reference to the development of the discipline nor to the state of the field.

2. The process of science and its human attributes are neglected, both of which are the characteristic features of scientific enterprise. Emphasis is upon describing what is known rather than how it is known, and upon answering questions rather than deciding what questions should be asked.

3. Too many topics are covered, and consequently, no topics are developed in depth.

4. Tissues and organs are the only two levels of organization emphasized.

5. Descriptive material is the dominant content of the course. A close look at the program of instruction in grades six and seven, for example, reveals that it is largely confined to a classification of multicellular plants and

animals, based on a description of morphology and structural anatomy which undoubtedly has little practical application in routine living. A tendency to emphasize anatomy is also found elsewhere in the program.

6. Efforts are apparent in the texts to change the lecture-dominated teaching style by encouraging laboratory practice and field work. Laboratory practice consists of exercises for developing manipulatory skills and obtaining a right answer when all the directions are followed.

The authoritarian teaching style does predominate in biology. The structure of the course content and the laboratory approach do not encourage the development of scientific thinking skills as an outcome of biology teaching. The laboratory program is simply regarded as a means of lecture control. In summary, then, though the secondary syllabus shows steady progress, there is little evidence of real change in the classrooms or texts.

The Training of Biology Teachers

In this section, an attempt is made to present and analyze the developmental background of the teacher training programs in biology for secondary schools in Vietnam, with special reference to the training program at Cantho University. The program is viewed in the light of the currently stated objectives of biology teaching for Vietnamese secondary schools and the needs of manpower training for the Mekong Delta region.

The Original Training Program in Science

Biology was introduced as a secondary school (6-12) subject much earlier than a teacher education program at that level. The preparation of teachers to teach biology was started with the first higher education institution, the University of Hanoi, in 1907; however, this program was only for the junior high level. Nineteen school teachers[1] were prepared by the end of the first year, when the University was closed due to political unrest. The University was allowed to resume its activities in 1917, after a ten-year suspension.[2] The Higher School of Pedagogy (Ecole Superieur de Pedagogy) continued the preparation programs. Overall goals, admission criteria, and the program of studies were reconsidered in an arrete issued in 1918.[3]

There were only two sections of study: one section of literature and one of science. The admission requirements were junior high graduation, and the duration of training was three years. A discussion of the program of training in science (Table 3) and the training courses in biology follows.

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[1]Coyle, op. cit., p. 56.

[2]Albert Sarraut, "L'Indochine en 1917," Revue Indochinois, XXVIII, 11-12 (November-December, 1917), 325.

[3]General Gouvernement de l'Indochine, Reglement General de l'Enseignement Superieur, Arrete du 25 Decembre, 1918 (Hanoi-Haiphong: Imprimerie d'Extreme Orient, 1919), pp. 73-76.

Table 3.--Program of training in science (per hour per week).

Subjects	Years 1st	2nd	3rd
Academic requirements:			
French	2	2	2
Mathematics	3	3	2
Physics	2	2	2
Chemistry	2	2	2
Natural history	2	1	1
Concepts of agriculture	1	1	1
Drawing	2	2	2
Hygiene	1	1	1
Professional requirements:[1]			
Psychology and morale			
Pedagogy	3	3	3

[1]It was also noted that the students' presentations in class, the methods of teaching, the instructional media, and practice teaching were required during the third year.

Source: General Gouvernement de l'Indochine, Reglement General de l'Enseignement Superieur, Arrete du 25 Decembre, 1918 (Hanoi-Haiphong: Imprimerie d'Extreme Orient, 1919), pp. 73-76.

The training courses in biology:

First year: In-depth instruction on subjects taught in the junior high grades.

Second year: Laboratory practice in botany and botany field trips; preparation of plant collections. Students' presentation on subjects taught at the first two years of junior level.

Third year: Laboratory practice in zoology. Students' presentation on subjects taught in ninth grade.

In addition, the concepts of agricultural economics were also included to teach agricultural practices. It is interesting to outline the major topics included in the agriculture curriculum:

First year: General agriculture, considering concepts necessary for and related to cultivation (soil, fertilization, drainage, crops, conservation of products, agricultural economics, etc.).

Second year: Special agriculture--special crops in the colony, cultivation techniques, and agricultural industry.

Third year: Students' presentation of topics related to the previous instruction with the teachers' guidance.

There was no statement of objectives for the training program. Instead, it was understood that a "teacher was prepared to teach the curriculum" which made up the framework of training courses. As a matter of fact, the training program was an extension of biology teaching in junior high school, being taught in more detail both in its content and its methodology. Goals were stated as:

1. To understand beneficial and detrimental plants and animals found in the living environment, and

2. To develop observation skills.

Success in training qualified the prospective teachers, with no discrimination as to teaching assignment, to instruct any science subjects at the junior high level.

Modification in terms of admission standards was made in 1930;[1] from then on, high school graduation was an admission requirement. The preparation of science teachers at the senior high level was untouched, and principally entrusted to the French teaching staff. At the onset of the national education movement, those with bachelors degrees in Natural Sciences from the Faculty of Science were invited to fill senior high teaching positions. The Higher School of Pedagogy continued its procedure throughout the period of French control.[2] Because of political events, the institution of Pedagogy moved to Saigon in 1954, and resumed its training for junior high schools.

A Complete Secondary Training in Biology

The year 1957 marked a turning point for higher learning in Vietnam. The Higher School of Pedagogy changed its status to the Faculty of Pedagogy attached to the University of Saigon, and in 1959 adopted a three-year program of specialization in the fields covered in the senior high school curriculum.[3] The length of the training period and

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[1]Coyle, *op. cit.*, p. 80.

[2]*Ibid.*, pp. 82-83.

[3]Hattie Jarmonm, Ellsworth Gerritz, and William S. Pattrick, *Republic of Vietnam: A Study of the System of Higher Education and Guide to the Admission and Academic Placement of Vietnamese Students in Colleges and Universities in the U.S.A.* (AACRAO, 1970), p. 44.

the admission requirements were subjected to change prior to 1965.[1] Actually, the training in biology for secondary schools (grades six through twelve) has only been undertaken at the Faculty of Pedagogy of Saigon with three types of programs: (1) the accelerated and (2) the regular programs of two years for training junior high school teachers, and (3) the regular four-year program to train senior high school teachers.[2] The training in biology for senior high teachers has also been provided by the Faculty of Pedagogy of Hue and for the junior high by the Faculty of Pedagogy of Cantho.

In general, having grown out of the original pattern of training teachers capable of teaching various science subjects, the actual preparation programs consist of specialized training in a single subject or a combination of subjects such as in mathematics or in natural sciences (a combination of biology and geology) for both junior and senior high schools. Admission standards and academic and professional requirements are identical in accordance with the training level at the three training centers in Saigon, Hue, and Cantho.

It should be noted that beginning in 1960, private universities (where students pay their own tuition) started to grow. In 1971, a private university was opened in the

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[1] _Ibid._, p. 45.

[2] Phan My Linh, _op. cit._, p. 56.

Mekong Delta. Currently, there are nine universities in operation, including three public universities (where tuition is nominal). A wide range of subjects is offered to satisfy different interests. Nevertheless, teacher training has not been taught at the private universities to date. The reason for this might be because of difficulty in getting jobs and low teachers' salaries. Therefore, the teacher training program is exclusively executed by three state-financed universities.

Case Study of Biology Training in the Mekong Delta

Goals.--Attached to the University of Cantho, the first higher education institution in the Mekong Delta region opened in 1966. The Faculty of Pedagogy immediately started programs to train teachers to instruct different subjects covered in the junior high curriculum, because of a serious shortage of teachers in the region. Graduates of the training centers of Saigon and Hue usually refuse appointments to cities in the Mekong Delta, due to poor transportation, lack of accommodations, and insecurity.

Table 4 gives the actual numbers of qualified and unqualified biology teachers in each province of the Mekong Delta.[1] Since the opening of the University of Cantho, secondary school enrollments have steadily increased in

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[1]Qualified teachers are those who sucessfully passed the training program at their training centers. The unqualified are those who have not received such training.

each province of the region (Table 5), which simply indicates larger demand in preparation.

Table 4.--Number of high school teachers teaching biology in the Mekong Delta region.

	Qualified Teachers			Unqualified Teachers		
Province	Junior High	Senior High	Total	Junior High	Senior High	Total
1 An Giang	6	9	15	1	0	1
2 An Xuyen	0	0	0	3	0	3
3 Ba Xuyen	0	4	4	0	0	0
4 Bac Lieu	2	2	4	2	0	2
5 Chau Doc	5	3	8	3	0	3
6 Chuong Thien	0	0	0	0	0	0
7 Dinh Tuong	8	16	24	8	0	8
8 Go Cong	2	4	6	1	0	1
9 Kien Giang	2	5	7	3	0	3
10 Kien Hoa	8	6	14	6	0	6
11 Kien Phong	2	3	5	1	0	1
12 Kien Tuong	0	2	2	1	0	1
13 Phong Dinh	1	9	10	3	0	3
14 Sa Dec	8	4	12	5	0	5
15 Vinh Binh	1	1	2	2	0	2
16 Vinh Long	6	4	10	6	0	6
Total			123			45

Source: Republic of Vietnam, Ministry of Education, List of Employees and High School Teachers of Provinces in the Mekong Delta Region, Directorate of Examination, March, 1972 (in press).

General admission and requirements.--Prospective teachers are selected on the basis of high school graduation and successfully passing a competitive entrance examination. The training period is for two years. The number of students to be admitted annually depends on the budget, and has varied from twenty-five to forty for each training subject. Faced with the increasing school enrollments in

Table 5.--Number of students by provinces.

Province	Junior High Level			Senior High Level		
	66-67	67-68	68-69	66-67	67-68	68-69
1 An Giang	10,267	11,874	13,819	1,951	2,556	3,394
2 An Xuyen	2,301	2,841	3,517	344	321	408
3 Ba Xuyen	5,534	6,169	6,825	1,097	1,443	1,048
4 Bac Lieu	2,949	3,314	3,642	328	414	433
5 Chau Doc	5,595	6,629	7,729	969	1,026	1,189
6 Chuong Thien	1,214	1,606	1,671	107	120	...
7 Dinh Tuong	12,513	13,040	14,731	3,266	4,106	4,631
8 Go Cong	3,112	3,331	4,115	784	810	870
9 Kien Giang	5,130	5,753	6,698	890	1,180	1,457
10 Kien Hoa	8,476	9,401	10,468	1,653	1,847	2,206
11 Kien Phong	2,968	4,593	5,046	576	559	696
12 Kien Tuong	398	529	720	58	71	61
13 Phong Dinh	8,780	9,956	1,216	1,825	2,069	2,267
14 Sa Dec	3,280	4,451	6,138	624	692	972
15 Vinh Binh	5,191	5,079	5,468	960	1,043	1,190
16 Vinh Long	89,694	102,627	101,970	32,588	38,732	41,100

Source: Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), p. 131.

the Mekong Delta region, the Faculty last year adopted an accelerated training program. This program is similar to the regular program in terms of admission requirements described above and also in its academic requirements given in Table 6, unless the prospective teachers are fully exposed to the practicing schools after their first training period of eight months.[1] On the average, the Faculty graduates about thirty-five to forty-five junior high school biology teachers each year, who will be appointed to high schools located in the Mekong Delta region. Selection of a school location is determined by the students' achievement during the final year.

Training courses in biology.--Six training courses in biology are part of the training program of junior high school teachers in natural sciences, including the methods course for teaching this subject. They are:

1. Zoology for secondary school and laboratory
2. Botany for secondary school and laboratory
3. Introductory animal biology and laboratory
4. Fundamentals of botany and laboratory
5. Animal physiology
6. Methods of teaching natural sciences

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[1]University of Cantho, "Some Features of the Faculty of Pedagogy," Dat-Nhan (Attained Man), II, 1 (January-February, 1972), 2.

Table 6.--Program of training in natural sciences.

Course Titles	Hours/Week	Credits
Freshman Year		
Introductory Animal Biology	2	2
Introductory Animal Biology Lab.	3	1
Fundamentals of Botany	2	2
Fundamentals of Botany Lab.	3	1
Fundamentals of Physics	2	2
Fundamentals of Physics Lab.	2-1/2	1
Fundamentals of Chemistry: General and Inorganic Chemistry	1	1
Fundamentals of Chemistry: Organic Chemistry	1	1
Fundamentals of Chemistry Lab.	2-1/2	1
Fundamentals of Mathematics	1	1
Introductory Geology	2	2
Introductory Geology Lab.	3	1
Foreign Language	1	1
Electives:		
History of Science, or	1	1
Sociology	1	1
	29	19
Sophomore Year		
Educational Psychology	1	1
General Education	1	1
School Administration	1	1
Science Education	2	2
History and Philosophy of Science	2	2
Methods of Teaching Natural Sciences	1/2	1/2
Practice Teaching of Physical Sciences	1-1/2	1-1/2
Practice Teaching of Natural Sciences	1-1/2	1-1/2
Zoology for Secondary School	2	2
Zoology for Secondary School Lab.	3	1
Botany for Secondary School	1	1
Botany for Secondary School Lab.	2	1
Animal Physiology	2	2
General Geology	2	2
General Geology Lab.	3	1
Electives:		
Animal Physiology 2, or	1	1
Chemistry for Secondary School	1	1
	27-1/2	22-1/2

Source: Official data.

The first two courses are the revision of materials given in junior high school. The next three courses, selected from among the academic requirements of the natural sciences majors, constitute the fundamental courses of the training program and consist of the topics listed below.[1]

Description of the training courses:

<u>Introductory Animal Biology</u>

Part I: Cytology:
- Methods of observing cell
- Structure of cytoplasm constituents
- Nucleus and chromosomes
- Cell division

Developmental Stages of Animals:
- Spermatogenesis
- Parthenogenesis
- Experimental embryology
- Embryonic foldings
- Formation of different tissues

Part II: Heredity:
- Discoveries of Mendel. Laws of Mendel on heredity
- Chromosomic theories in heredity
- Linkage and crossing-over. Map of chromosomes.
- Sex determination. Sex-linked characteristics
- Mutation
- Heredity in man

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[1]University of Cantho, <u>Handbook of the Faculty of Sciences, 1971-1972</u>, <u>op. cit.</u>, pp. 16-17, 19, 27.

Classification:

-General classification of animal phylum

-Summary notions of animal division from protists to vertebrates

Morphology:

-Comparative study of vertebrates

Laboratory: Observe external and internal structures of fish, frog, reptile, bird, rodent, cockroach, grasshopper, lobster, crab, and snail

<u>Fundamentals of Botany</u>

Part I: -General characteristics of plants

-Plant cell (characteristics, anatomy, structure)

-Plant tissue (types, structure, function)

-Organs of functions: root, stem, leaves

Part II:-Sexual reproduction of angiosperms: flower, fruit, seeds (its biology, morphology, growth)

-Reproduction of gymnosperms, of ferns, and of thallophytes. Life cycle of these groups

-Vegetative reproduction

-Taxonomy of angiosperms

Laboratory:

-Manipulation of microscope and binoculars

-Observation of different structures of cells and tissues

-Study of organs: stem, root, leaf, stamins,

ovary and floral analysis of monocotyledons and dicotyledons
- Biology of fruit, seeds, germination
- Field trips for making plant collection

Animal Physiology

- Function of nutrition
- Digestion, circulation, excretion, respiration and its physiology
- Blood coagulation
- Suffocation. Sweat excretion. Bile secretion

Analysis of the description of these courses with reference to the biology curriculum in junior high school indicates that selection is made primarily with the intention of providing breadth and depth for prospective teachers in their training subjects (Part II of Introductory Animal Biology, Part II of Fundamentals of Botany and Animal Physiology). However, a duplication of lectures on the fundamental or basic principles and concepts within the first two courses cannot be avoided. The fundamental courses provide basic biology instruction; however, they fail to provide a scientific literacy to prospective teachers, as the current status of biology is more advanced. On the other hand, despite courses and accompanying laboratory work which are designed for biology majors, the laboratory work is basically illustrative and concentrates on developing observation skills and on developing manipulatory skills by practice of dissecting. As a matter of fact, different components of the process of science are not even fully conveyed.

Teachers teach what they have been taught. Indeed, biology teaching in secondary schools is conducted in the same manner in which it has been taught at college. Therefore, the methods of teaching natural sciences need to be reoriented to enable the prospective teacher, whose knowledge does not extend beyond his notes and who is unprepared, to find references for information and to show him how to get help. To become acquainted with various teaching approaches, instructional materials, and equipment to carry out the stated goals of biology teaching in secondary schools, these teachers will need assistance.

Although the goals of Cantho University were explicitly stated as to develop the Mekong Delta region and to serve its people, the curriculum training does not reflect any needs of the region, but rather a duplication of the training pattern from other training centers.

In short, the syllabus of secondary schools is calling for innovations in its stated objectives and methodology of biology teaching. Evidence of change is minimal and somewhat superficial, since the training program does not provide the groundwork for change: the provision of scientific literacy appears to be insufficient and inadequate. The process of science is not likely to be fully understood from the courses given, because it is not incorporated into them.

Summary of the Chapter

In this chapter, an attempt has been made to outline the evolution of biology education in the Vietnamese schools through a presentation of the components of (1) biology teaching in Vietnamese secondary schools and (2) the training of biology teachers. Special reference is made to the program for training biology teachers for secondary schools, which is conducted at Cantho University, the first higher education institution to assume a responsibility for serving its local communities. The existing training pattern has not achieved its goal, since it lacks both "local" characteristics and a "modern" training program to enable its prospective teachers to manage the innovative objectives that the syllabus has called for, in order to bring real evidence of change into the classrooms. An effort is made in the following chapters to investigate the prominent features of the Mekong Delta region, which must be interpreted in a relevant training program. Also, a more effective approach for a modern training program is developed.

CHAPTER III

SOCIO-ECONOMIC ASPECTS AND NATURAL RESOURCES OF THE REGION

Introduction

It is apparent that socio-economic factors in any country are likely to affect its people's welfare the most. Thus, to construct a training program which has a practical application to a community, the selection of a structure for the training program upon which the major courses are to be built should be derived from the socio-economic structure of the community.

In this chapter, an attempt is made to identify economic characteristics as well as significant social problems facing the people in the Mekong Delta region. A basic structure for the training program of prospective biology teachers will be formulated from these findings.

Economic Features

Most developing countries have an agriculture-based economy; Vietnam belongs in this category. Not only do agricultural products establish the principle assets in the exchange market with foreign countries,[1] but the majority

[1] Thai van Kiem, Vietnam Past and Present (Saigon: Ministry of Education, 1957), p. 199.

of them are also available for domestic consumption. Rice is the leading crop (Table 7), and it has been the primary export product in previous years, as Vietnam was one of the most important rice-producing countries in Southeast Asia.[1]

Among the three regions--the Central Highlands, the Central Lowlands, and the Southern region--divided for administrative purposes, the largest amount of rice production comes mainly from the Southern region (Table 8), in which the Mekong Delta produces the most rice (Table 9). Part of the production is sold for local consumption, while the excess is distributed to other regions in the country. The Mekong Delta region has long been justly regarded as the "rice basket" of South Vietnam.

After rice cultivation, fisheries are second in economic importance in the Mekong Delta region, including both the inland and marine fisheries. The production of this region alone accounts for approximately 50 per cent of the country's total production (Table 10). The inland fishery is as important as the marine fishery (Table 11), and both are still underexploited. The kinds of inland fish are satisfactory for domestic consumption, whereas the marine fish, especially the Polymenus sp., a kind of sea fish exclusively exploited along the tip of Camau[2] and

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[1]James B. Hendry, The Study of a Vietnam Rural Community: Economic Activity (East Lansing: Michigan State University Vietnam Advisory Group, December, 1959), p. 1.

[2]Republic of Vietnam, Agricultural Statistics Yearbook, 1970 (Saigon: Ministry of Land Reform, Agriculture, Fishery and Animal Husbandry Development, October, 1971), pp. 26-27.

Table 7.--Agricultural crops: cultivated area and production.

	Cultivated Area (Hectares)					Production (Metric Tons)				
	1966	1967	1968	1969	1970	1966	1967	1968	1969	1970
Food crops										
Paddy	2,294,780	2,295,800	2,393,800	2,430,000	2,510,700	4,336,390	4,688,400	4,366,150	5,115,000	5,715,500
Corn	29,180	28,955	28,780	28,565	28,640	35,390	33,820	31,760	30,535	31,435
Sweet potatoes	39,480	37,800	34,520	34,850	32,860	245,110	254,010	234,685	225,560	219,750
Manioc	38,960	36,500	35,130	32,150	30,380	280,280	261,855	260,190	233,485	215,710
Potatoes	190	100	100	200	200	3,730	1,500	2,000	4,000	4,000
Peanuts	30,640	30,150	29,680	31,295	30,240	34,420	33,730	32,055	34,410	32,185
Soybeans	6,610	7,555	7,820	6,545	6,835	7,585	5,660	7,465	5,965	7,455
Mungo beans	20,050	30,560	21,405	16,330	16,600	14,410	19,920	13,360	11,690	11,095
Vegetables	12,000	13,540	13,620	16,885	17,850	166,485	192,180	193,055	234,955	217,550
Pineapple	5,560	5,750	4,540	4,265	4,475	38,790	37,020	34,110	33,255	33,325
Bananas	18,120	17,860	17,730	19,210	19,955	177,250	167,555	164,065	183,760	203,635
Fruit trees[1]	35,990	33,730	32,340	32,030	32,920	201,900	191,165	221,880	222,885	235,705
Black pepper	390	390	340	370	340	440	470	410	435	410
Sesame	495	550	430	370	430	225	280	235	210	235
Yam beans	1,135	1,470	1,105	1,155	1,260	6,215	9,140	5,680	6,110	6,220
Watermelon	3,445	4,550	4,510	3,445	4,200	31,590	46,695	46,950	35,200	42,000
Other tubers	790	1,040	1,155	1,360	1,400	4,350	9,640	10,225	11,265	11,300
Fiber crops										
Kepaf	665	130	200	80	80	615	160	200	80	80
Jute	740	775	560	250	250	790	770	525	250	250
Cotton	90	80	80	80	80	40	40	40	40	40
Kapok	1,540	1,275	1,190	1,185	1,150	730	872	825	815	810
Ramie	15	5	5	5	5	10	5	5	5	5
Industrial crops										
Rubber	126,340	115,735	105,730	104,950	105,800	49,455	42,510	34,000	27,650	33,000
Tea	8,150	7,125	7,660	8,270	8,215	5,210	4,195	4,770	4,900	5,545
Coffee	10,230	10,240	10,000	9,480	9,360	3,070	3,345	3,000	3,550	3,925
Coconuts	39,015	38,110	29,905	32,985	32,250	129,460	130,500	110,705	98,545	118,450
Tobacco	7,150	8,455	8,100	8,270	8,525	6,900	7,890	7,620	7,790	8,420
Sugar cane	30,050	25,770	15,265	11,670	11,620	935,670	769,960	401,070	321,445	335,720
Lacquer resin	50	50	70	160	160	5	5	...	...	...
Cacao	150	140	60	50	50	45	45	25	25	25
Other crops										
Mulberry	1,405	920	655	540	340	7,340	4,245	2,945	2,560	1,575
Areca nuts	1,125	1,240	980	950	860	1,140	930	665	420	435

[1]Excluding bananas.

Source: Republic of Vietnam, Agricultural Statistics Yearbook, 1970 (Saigon: Ministry of Land Reform, Agriculture, Fishery and Animal Husbandry Development, October, 1970), pp. 26-27.

Table 8 .--Cultivated area and production of rice in respect to the whole country and different areas.

	Cultivated Area				Production				Yield/Ha	
	1969	%	1970	%	1969	%	1970	%	1969	1970
Vietnam	2,393,800	100	2,430,000	100	4,366,150	100	5,155,000	100	1,824	2,105
Southern Region										
Mekong Delta	1,656,000	69	1,657,200	68	3,094,200	71	3,653,000	70	1,865	2,138
Eastern Region	272,600	11	308,600	13	567,800	13	654,400	13	1,899	2,191
Central Lowlands	417,500	19	416,500	17	655,600	15	752,000	15	1,570	1,805
Central Highlands	47,700	1	47,700	2	48,550	1	55,600	2	1,080	1,166

Source: Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), p. 36.

Table 9.--Rice: cultivated area and production classified by region.

Year	Cultivated Area				Production			
	Central Highlands	Central Lowlands	Southern Region	Vietnam	Central Highlands	Central Lowlands	Southern Region	Vietnam
	Hectares				Metric Tons			
1955-56	83,000	358,110	1,802,810	2,243,920	80,000	441,325	2,318,000	2,839,325
1956-57	105,000	375,220	2,060,030	2,540,250	135,000	536,120	2,740,950	3,412,070
1957-58	105,000	489,150	2,124,870	2,719,020	62,500	587,460	2,541,610	3,191,570
1958-59	74,270	514,590	1,702,360	2,291,220	77,780	680,290	3,476,940	4,235,010
1959-60	86,130	503,995	1,809,875	2,400,000	94,780	883,800	4,113,420	5,092,000
1960-61	87,550	481,200	1,749,290	2,318,040	99,720	707,055	4,148,100	4,954,875
1961-62	69,700	460,500	1,823,100	2,353,300	66,700	790,500	3,749,700	4,606,900
1962-63	60,540	493,460	1,924,860	2,478,860	55,270	853,310	4,296,460	5,205,040
1963-64	71,720	500,590	1,965,210	2,537,520	60,630	902,520	4,363,530	5,326,680
1964-65	69,500	533,600	1,953,700	2,556,800	69,000	910,760	4,205,270	5,185,030
1965-66	62,880	489,100	1,876,660	2,428,640	58,800	791,000	3,971,850	4,821,660
1966-67	55,600	420,400	1,818,780	2,294,780	52,700	744,300	3,539,390	4,336,390
1967-68	49,200	414,600	1,832,000	2,295,800	57,100	727,400	3,903,900	4,688,400
1968-69	47,700	417,500	1,928,600	2,393,800	48,550	655,600	3,662,000	4,366,150
1969-70	47,700	416,500	1,965,800	2,430,000	55,600	752,000	4,307,400	5,115,000
1970-71	47,700	418,500	2,045,000	2,510,700	59,000	845,000	4,811,500	5,715,500

Source: Republic of Vietnam, Agricultural Statistics Yearbook, 1970 (Saigon: Ministry of Land Reform, Agriculture, Fishery and Animal Husbandry Development, October, 1970), p. 34.

Table 10.--Total fisheries catch classified by region (in metric tons).

	1965	1966	1967	1968	1969
Vietnam	205,384	357,519	398,200	403,000	458,844
Southern Region					
Mekong Delta	104,334	165,152	155,000	158,479	184,346
Eastern Region	29,672	36,284	39,985	42,656	40,895
Central Lowlands	71,378	156,083	203,215	201,865	233,703

Source: Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), pp. 64-68.

Table 11.--Total fisheries catch in 1969 by categories (in metric tons).

	Marine	Inland	Shrimp	Crab	Cuttle Fish
Vietnam	335,488	63,773	27,504	13,370	3,809
Southern Region					
Mekong Delta	61,530	56,798	17,853	10,045	9
Eastern Region	76,218	1,990	2,954	656	2,088
Central Lowlands	217,740	4,885	6,697	2,669	1,712

Source: Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), pp. 64-68.

a sizable quantity of frozen shrimp largely from the Mekong Delta, continue to support the export balance of agricultural products.

Significantly enough, the Mekong Delta region is not only an important rice growing area but also a fishing ground of great potential. Of utmost importance, rice is the number one item in the Vietnamese diet. After rice, fish is an indispensable element and the main source of animal protein. In fact, the Mekong Delta is actually the principal source of the food supply in South Vietnam.

The two dominant economic activities and the related activities of processing agricultural and fishery products engage all of the Mekong Delta population, about six million people or approximately one-third of the population of South Vietnam.[1] Economically speaking, the living standard is very low, characterized by a low per capita income of between $90 and $150 per year.[2] This is because agricultural and fishery practices are basically primitive, although the region possesses a significant potential supply of natural resources in agriculture and fisheries.

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[1]Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), pp. 380-381.

[2]Committee for the Coordination of Investigations of the Lower Mekong Basin, Report on Indicative Basin Plan: A Proposed Framework for the Development of the Water and Related Resources of the Lower Mekong Basin, E/CN.11/WRD/MKG/L.340, 1970, pp. 1-2.

The most significant resource is the Mekong River, one of the longest and most powerful rivers in the world. Rising in the perpetual snows of the Himalayan mountains in China, the Mekong winds along the borders of Burma, Laos, and Thailand, traversing central Cambodia where it divides into two branches--the Mekong and Bassac. In South Vietnam, the two rivers form a broad delta before emptying through many mouths into the South China Sea below Saigon (see Figure 2). The Mekong annually floods and discharges its overflow water, causing floods in large areas surrounding the main stream and the Bassac and its tributaries. The depth of water may rise to 2-3m,[1] or sometimes higher.

The flooding behavior of these rivers is beneficial for the inland fisheries. In fact, it causes the enlargement of the Great Lake in Cambodia, one of the most productive bodies of water, which is connected with the Mekong by the Tonle-Sap River. Fish follow the water into the rice fields and numerous rivers and canals in the Delta when the Tonle-Sap reverses its streams.[2]

The potential of marine fishing is also high, since the region has a continuous, enclosed coastline facing the Gulf of Thailand to the west and the South China Sea to the

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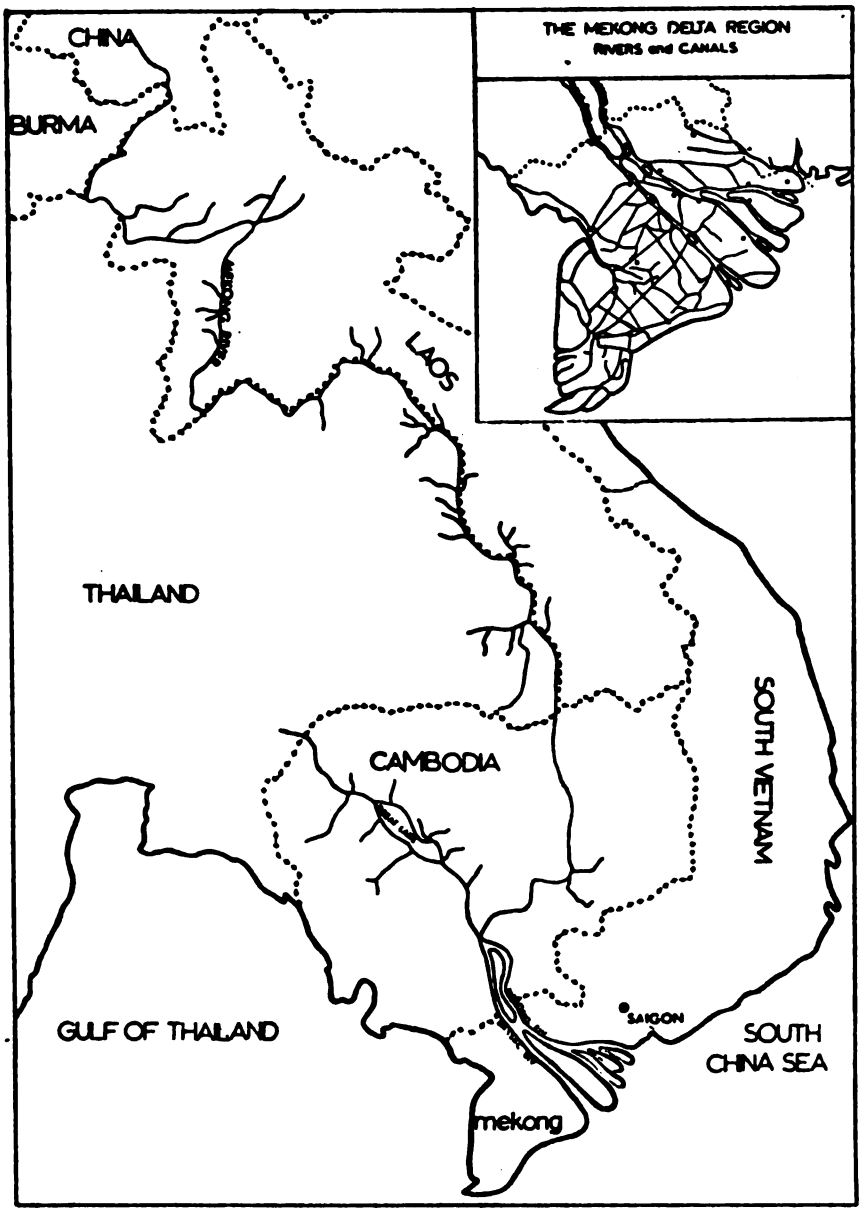
[1] Ibid., pp. 14-60.

[2] Le van Dang, Present Situation and Possibilities of Postwar Development of Inland Fisheries in the Mekong Delta, Joint Development Group, Working Paper No. 42 (Saigon: November, 1968), pp. 5-20.

THE MEKONG RIVER



Source: **Republic of Vietnam,** Map of Vietnam (Dalat: National Geography Institute, 1966).

Figure 2.--The Mekong River and the Mekong Delta region rivers and canals.

south and the east (Figure 2). From 1959 to 1961, the Naga Expedition conducted an experimental survey of "Ecology of the Gulf of Thailand and the South China Sea" to investigate the physical and biological factors contributing to the development of marine fisheries, in response to the demands made on the fisheries to provide protein in the face of population increase.[1] Brinton indicated in his report that the coastal waters belonging to the Mekong region of South Vietnam and bounding two special provinces of Kien-Giang and An-xuyen yielded three to five times as much plankton as the South China Sea.[2] Of significant importance is a positive correlation between the density of plankton and the density of plankton-feeding fish population.[3]

On the other hand, compared to the Nile or the Mississippi, the Mekong carries a relatively small quantity of alluvium.[4] Its sediments are deposited during the flooding period in low-lying areas. The Mekong Delta region is extremely flat, comprised of plains and lowlands under five

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[1]Food Agriculture Organisation, Ecology of the Gulf of Thailand and the South China Sea (La Jolla: Scripps Institution of Oceanography, 1953).

[2]E. Brinton, "Zooplankton Abundance in the Gulf of Thailand and the South China Sea," in Ecology of the Gulf of Thailand and the South China Sea (La Jolla: Scripps Institution of Oceanography, 1963), p. 57.

[3]Tham Ah Kow, "The Role of Planktonology in Fisheries Development," in Symposium on Marine and Fresh Water Plankton in the Indo-Pacific (Bangkok: Indo-Pacific Fisheries Council, January 25-26, 1954), p. 18.

[4]Thai cong Tung, Natural Environment and Land Use in South Vietnam (Saigon: Ministry of Agriculture, Directorate of Agriculture Research, October, 1967), p. 43.

meters above the sea level,[1] except on the western end where a few broken hills rise several hundred meters (Map 2). Its soil has a recent origin as the result, in part, of rock weathering of the substratum which is of basaltic-type sediment formed in the Quaternary Era,[2] but, in larger part, from the sedimentation of the detrital materials carried by the rivers.

According to Thai cong Tung, there are four types of soils in the Mekong Delta region: alluvial soils, acid soils, saline soils, and organic soils.[3]

The alluvial soils deposited along the river banks are rich in nitrogen and potassium, but are poor in lime and phosphorus;[4] they are moderately productive. The saline soils and the acid soils comprise most of the area,[5] and become highly productive only after appropriate drainage. In fact, the acid soils have been formed on brackish sediments containing iron sulfides, which are oxidized with the

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[1]Joint Development Group, _The Postwar Development of the Republic of Vietnam: Policies and Programs_, Vol. II (Saigon: Postwar Planning Group, March, 1969), p. 507.

[2]The Engineer Agency for Resources Inventories and the Tennessee Valley Authority, _Atlas of Physical, Economic and Social Resources of the Lower Mekong Basin_ (New York: United Nations, September, 1968), p. 18.

[3]Thai cong Tung, _op. cit._, p. 43.

[4]F. R. Moorman, _The Soils of the Republic of Vietnam_ (Saigon: Ministry of Agriculture, 1961), p. 3.

[5]Joint Development Group, _op. cit._, p. 511.

formation of sulfuric acid when the sediments dry out.[1] The pH may drop even below three[2] and the soils become unproductive for crops. Fresh water drains the elements of acid to improve the acid soils. Therefore, hydrology becomes the dominant factor affecting the exploitation of soils in the Mekong Delta.

The Mekong is the significant water supply resource, as each year an average of more than 475,000 million m^3 water flows.[3] In addition, the region is governed by the monsoon winds, with the rainy season lasting for six months and the annual rainfall averaging about 1800mm.[4] In fact, there is more water than needed by crops during the rainy season, due to intensive precipitation and flood waters discharged by the Mekong. What cannot be stored runs off the land. During the dry season, however, the water becomes so short in supply that most lands are left uncultivated. Since farmers are unable to control the water, rice cultivation yields a single crop each year.

The Mekong River, as a substantial natural resource of the Mekong Delta region, is the subject of several comprehensive national and international projects[5] aimed at

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[1]Moorman, op. cit., p. 3.

[2]Thai cong Tung, op. cit., p. 44.

[3]Indicative Basin Plan, op. cit., p. 1.

[4]Vietnam Statistical Yearbook 1970, op. cit.

[5]Embassy of Vietnam, "Vietnam Agriculture," Vietnam Bulletin, XLIV (March, 1971). In addition to international projects cited in the above references are the Engineer Agency for Resources Inventories, the Joint Development Group, and the Indicative Basin Plan.

realizing the full crop production potential of the Mekong Delta in response to increasing domestic and export requirements.

In any case, if resources such as water and land are essential natural ingredients for regional development, it is the human resources that constitute the active force of any such development.

Social Concerns

The Mekong Delta region is comprised of sixteen provinces, encompassing almost six million inhabitants. It is the second most densely populated area in South Vietnam (Table 12). Serving as a center of commerce, each province capitol is usually crowded; in fact, some large provincial cities may contain a population of 50,000 to 100,000.[1] However, the larger part of the population, over 80 per cent,[2] is scattered throughout the countryside in hamlets or villages.

A large system of rivers and canals connects with the Mekong tributaries, running across the cities and the countryside and providing sites for houses or hamlets that are preferably grouped along the river banks. If water is indispensable for maintaining life, then the water supply for routine living in the Mekong Delta is a matter of real

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[1] Report on Indicative Basin Plan, _op. cit._, pp. II-8-9.

[2] Harvey Meyerson, _Vinh Long_ (Boston: Houghton-Mifflin, 1970), p. 3.

concern. In fact, even in large cities, a system of running water is still limited and not considered safe for drinking purposes. Entire hamlets and villages have no water system at all. A few families collect rain water in large cisterns or earthen jars for drinking, principally during the dry season. The majority, when running water is in short supply or unavailable, are virtually dependent on water from rivers, ditches, canals, or even shallow pools.

Table 12.--Population in 1970.

Regions	Area (km^2)	Population	%	Density
Vietnam	174,289	17,333,388	100	99
Southern Region				
Mekong Delta	37,229	5,978,883	35	160
Eastern Region	31,943	5,232,163	30	164
Central Lowlands	55,705	5,215,653	30	94
Central Highlands	50,412	906,689	5	18

Source: Republic of Vietnam, Vietnam Statistical Yearbook 1970, Vol. 17 (Saigon: National Institute of Statistics, 1970), p. 380.

The untreated water is also used for bathing, laundering clothes, and washing animals. Incidentally, water courses are also used for waste disposal. Since garbage collection services are irregular and confined to main streets in towns, waste is discharged in the water courses.[1]

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[1]The Engineer Agency for Resources Inventories, op. cit., pp. 126-128.

Such practices lead to major water-borne diseases; in addition, the incidence of skin diseases and intestinal parasites is very common. Hickey, a sociologist and also an anthropologist, made the following observating during his study of a rural community in the Mekong Delta:

> In the course of carrying out field research in Khanh-Hau, practically every house was visited. . . . In most of these houses, there were individuals who complained of some ailment, and in some houses, there were people who were seriously ill. . . . There were many complaints of gastro-intestinal upsets. A number of children were suffering from skin eruptions of various kinds and many were debilitated by periodic diarrhea.[1]

In connection with water-borne disease, infection with other types of parasites is almost universal. Roundworm, hookworm, and tapeworm are common,[2] partially as a result of consumption of vegetables fertilized with animal manures, including human wastes, which are dissolved in water and applied directly to the plantules to provide organic matter lacking in the soil.[3]

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[1]Gerald C. Hickey, A Study of a Vietnamese Rural Community: Sociology (East Lansing: Michigan State University Vietnam Advisory Group, January, 1960), p. 224.

[2]George L. Harris and others, U.S. Army Area Handbook for Vietnam (Washington, D.C.: The American University, 1962), p. 181.

[3]M. Y. Nuttonson, The Physical Environment and Agriculture of Vietnam, Laos and Cambodia (Washington, D.C.: American Institute of Crop Ecology, 1963), p. 27. The practice of using animal manures is still in existence; chemical fertilizers have already been introduced but are expensive. To compromise the insufficient income of farmers and the need to enrich the organic matter of the soil, increased cultivation of green manures (hemp, azolla) was suggested as an effective treatment. Evidence of scientific significance which has recently been found by Tran phuoc

Finally, epidemics of germ diseases such as tuberculosis, cholera, malaria, and tetanus still remain the most serious menace to human health in the Mekong Delta[1] and cause a heavy death toll.[2]

On the other hand, causes of ill health are considered as misfortunes attributed to evil spirits[3] of various kinds abundant in nature, of dead persons without cults in their honors, and of inanimate objects. It is believed that these spirits have their own mystical power, which may alter the order of nature and cause disasters on the earth such as drought, flood, famine, and even illness. Hickey noted that:

> Children who appear to be suffering from chicken pox or small pox are permitted to mix freely with other children. The villagers believe that the skin pustules are caused by the wind. . . .[4]

Duong in "Nitrogen Fixation and Productivity in a Eutrophic Hard-Water Lake: In-Situ and Laboratory Studies" (unpublished Ph.D. dissertation, Michigan State University, 1972), pp. 133-148, supports the economical values of green manures. In fact, several identified green algae encysted in duckweeds (lemna and other genera) are capable of fixing nitrogen from the air. Hence the duckweeds can be used for a dual purpose--to enrich the nitrogen nutrient in the fields as well as the organic matter of the soil through the decomposition process of their living cells. Duong also proposed the use of duckweeds in the sewage treatment cycle.

[1] The Engineer Agency for Resources Inventories, *op. cit.*

[2] "Public Health in Vietnam," *Vietnam Feature Service* (Pubs -095) (Washington, D.C.: AID, May, 1971), pp. 24-26.

[3] Hickey, *op. cit.*, p. 224.

[4] *Ibid.*, p. 226.

Cooke had the same observation on this problem, and remarked on people's attitude toward the effectiveness of modern medicine in the following words:

> . . . Even when modern medicines are used to cure illness, the farmers do not believe germs have been killed, but that the medicines have helped chase the evil spirits away.[1]

Analysis of the major health problems, their causes, and people's beliefs and attitudes implies a lack of knowledge and understanding of the basis of illness. In spite of substantial medical care programs, which concentrate mainly on curative services,[2] the widespread occurrence of germ diseases and water-borne diseases does not show any sign of declining. Health education is needed as much as material assistance, to provide basic and proper information to allow healthy living conditions for individuals and their communities.

The medical beliefs, myths, and practices covered in the preceding section may account for the routine living practices of the majority of the population, which cause a heavy toll of infectious diseases and pollute the environment as a result. Regarding the polluted environment, the use of various kinds of chemical sprays in controlling disease as well as in the recent warfare should be noted. In fact, a tremendous amount of DDT has been used in living

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[1]Davis C. Cooke, Vietnam: The Country, the People (New York: W. W. Norton and Company, Inc., 1968), p. 56.

[2]Public Health in Vietnam, op. cit., p. 29.

areas and in the stagnant waters and swamps which prevail in the Mekong Delta region, in the program to eradicate malaria. However, application of DDT may cause additional environmental pollution. Evidence of DDT has been found to have an effect upon wild life, especially birds[1] and fish,[2] so that reproduction is seriously affected. Another incidence of chemical pollution is the spraying of chemical defoliates, which has been done intensively for military purposes since 1961.[3] The spraying of herbicides is a subject of much controversy, and the side effects of herbicide residues upon humans' welfare is under investigation.[4]

Implications and Conclusions

The analysis of the socio-economic factors in the Mekong Delta indicates that:

1. It is a region comprising the most important agricultural sector in South Vietnam.

2. Rice growing and fisheries are the two dominant

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[1] Roy T. Barker, "Notes on Some Ecological Effects of DDT Sprayed on Elms," Journal of Wildlife Management, XX, 3 (1958), 269-274.

[2] Howard E. Johnson and Robert C. Ball, "Organic Pesticide in an Aquatic Environment," Advances in Chemistry Series, No. III (1972), 1-10.

[3] Sheldon Novick, "Chemical War," Environment, XIII, 2 (March, 1971), 45-46.

[4] Arthur H. Westing, "Herbicides in War: Current Status and Future Doubt," Biological Conservation, IV, 5 (October, 1972), 326.

economic activities, which engage the majority of the population and thus affect their living standard.

3. Again, agriculture and fisheries are the major target of economic development projects in this region, based upon significant natural resources and production potentials of the area.

4. People living in this region, on the other hand, need health education emphasizing basic information on illness and reduction of superstition.

5. Information about ecological problems such as the use of animal wastes as fertilizers, the use of DDT sprays for malaria, and possible pollution of the environment must be imparted.

6. The population of the Mekong Delta region is second only to the major cities of Vietnam.

Summary of the Chapter

In this chapter, an analysis of the socio-economic concerns in the Mekong Delta region was made. Findings suggest desirable experiences are needed, based on the economic and social needs and demands of this particular geographical region. Experiences will be considered as the major emphasis in organizing the course content of the training program in biology.

CHAPTER IV

TRENDS IN MODERN BIOLOGY EDUCATION AND THEIR IMPLICATIONS IN SOUTHEAST ASIA

Introduction

This chapter deals with recent efforts to improve biology education. Included in the review are changes in content, instructional methods, and teacher training programs. Most of the data come from works done in the United States, which appears to be a leading country in terms of the development of new techniques and equipment for biology education. The investigation is also extended to explore implications in several recent meetings and conferences undertaken in Southeast Asia on biology education.

On the basis of the above considerations, an attempt is made to derive a set of modern materials and methodology for biology instruction. These will become part of the proposed program and give it "modern" as well as "local" characteristics related to the Mekong Delta region.

Trends in Modern Biology

The Curriculum Reform Movement

Curriculum reform has long been a slow process. The movement to reform biology education came in response to several recognized problems. In science, the explosive growth of scientific knowledge due to advanced techniques and new research tools[1] was a major factor. In education, the development of new tools in the social sciences (sociology, educational psychology); pressure on the curriculum to serve a broader range of student abilities, interests, and backgrounds; and the need to train better teachers[2] were important issues.

The movement progressed through several national and regional conferences concerned with improving biology education and the training of biology teachers.[3] These preparatory steps, however, did not come to public recognition until the launching of the first Russian Sputnik in 1957. This event stimulated action on numerous science curriculum projects in the United States.

In biology education, the first comprehensive project was the Biological Science Curriculum Study (BSCS). Concurrently, there were also a number of curriculum segments consisting of a new set of laboratory experiments,

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[1]Paul Dehart Hurd, Biological Education in American Secondary Schools, 1890-1960, Biological Science Curriculum Study (BSCS) Bulletin No. 1 (Baltimore: Wavely Press, Inc., 1961), pp. 108-109.

[2]Joseph J. Schwab, Biology Teacher's Handbook (New York: John Wiley and Sons, Inc., 1963), pp. 3-8.

[3]Hurd, op. cit., pp. 111-118; John Breukelman and Richard Armacost, "Report of the Southeastern Conference on Biology Teaching," The American Biology Teacher, XVII, 1 (1955), 4-45; Richard Armacost and Paul Klinge, "Report of the North Central Conference on Biology Teaching," The American Biology Teacher, XVIII, 1 (1956), 4-72; Thomas S. Hall, Chairman, Improving College Biology Teaching, National Academy of Science--National Research Council, Publication 505 (Washington, D.C., June, 1957), pp. 2-22.

some units of written instructions[1] and later several projects carried out on a smaller scale as an outgrowth of the BSCS Project.[2] In the present study, only the BSCS program is taken into consideration as a representative of the innovative trend in modern biology education. It has not only gained nationwide appreciation, but has also achieved international recognition.

Biological Science Curriculum Study (BSCS)

The BSCS project represents the first concerted effort in which working scientists, high school teachers, and educators cooperatively developed instructional materials for improving biology education in the high schools. In fact, the project was intended "to close the widening gap which more and more threatens to separate the classroom and the sources of increasing knowledge in the biological sciences."[3] The BSCS project sought answers to the following questions:

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[1]Paul Dehart Hurd, New Directions in Teaching Secondary School Science (Chicago: Rand McNally & Company, 1969), p. 131.

[2]William H. Gregory and Edward H. Goldman, Biological Science for High School (Boston: Ginn and Company, 1965). Also accompanied the Laboratory Manual and the Teacher's Edition by W.H. Gregory; G. Congdon Wood, ed., Biology Experiments for High School Students (New York: American Cancer Society, Inc., 1964.

[3]BSCS Newsletter, No. 3, May, 1960, p. 3.

1. What is the significant knowledge of living things as it is known in modern biology?
2. What attitudes and skills relevent to modern biology will contribute the most to the students' personal lives and to the execution of their responsibilities as men and citizens?[1]

Nine major conceptual themes were defined to provide a framework for responding to the two questions:

Change of living things through time: evolution
Diversity of type and unity of pattern in living things
The genetic continuity of life
The complimentarity of organism and environment
The biological roots of behavior
The complimentarity of structure and function
Regulation and homeostasis: Preservation of life in the face of change
Science as inquiry
The history of biological concepts[2]

Considered as essential content, these concepts are not used as major topics, but rather as "a warp binding the fabric of biology together,"[3] which permeates every chapter and underlies every discussion. The first seven themes define the content of the BSCS materials, and the last two convey the nature of science. The latter gives BSCS its innovative approach, in which biology is shown as a means of acquiring significant knowledge in science. This differs from the approach used in traditional biology teaching, where biology is shown only as a body of knowledge to be learned.

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[1]Hurd, New Directions in Teaching Secondary School Science, op. cit., p. 154.

[2]Schwab, op. cit., p. 31.

[3]Bently Glass, "The Philosophy of a Curriculum," BSCS Newsletter, No. 37, November, 1969, p. 2.

Such a new approach is, in fact, described in BSCS materials, both in theory and in practice. In theory, efforts are made to convey how scientific knowledge is generated by giving a narrative of the whole process of inquiry and by indicating the limitations, the uncertainties, and the incompleteness of science by the "liberal use of expressions" such as "we do not know" or "the evidence about this is contradictory," etc.[1] In practice, the most striking characteristic of the BSCS project is its emphasis on the laboratory, which is intended "to lead to an understanding of scientific inquiry and investigation."[2] The textbook is supplementary to learning. Schwab said, "Mere telling is not effective; the need is to exhibit science in operation, not only to talk about science."[3] Consequently, to convey a sense of scientific inquiry is to provide opportunities to engage in the procedures by which scientists manage to discover knowledge. It is felt that:

> The laboratory is where the work of science is done, where its spirit lives within the person who works there, where its methods are transmitted from one generation to the next. One does not learn science from books; one learns science by asking nature the right questions. And the laboratory is the place where one learns most rapidly what questions can be asked fruitfully and how they must be put. It is where one learns

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[1] Paul D. Hurd and Elra Palmer, "The BSCS Approach to High School Biology," in _BSCS Implementations in the Schools_, BSCS Bulletin No. 3, 1964, p. 4.

[2] BSCS, _The Teacher and BSCS Special Materials_, BSCS Special Publication No. 4, 1966, p. 4.

[3] Schwab, _op. cit._, p. 46.

> why science insists on precise measurement, accurate observation, and conciseness and clarity of observation.[1]

Thus, the BSCS laboratory is experimental and quantitative by design, which involves the application of the related sciences throughout the course of an investigation. In addition, the BSCS program has focused on providing multiple varieties of laboratory materials. The general pattern of the BSCS investigative exercises is as follows: From a given problem, students proceed to get acquainted with different experimental procedures; they manipulate instruments, collect and record data, and make observations. This activity phase is followed by a guided discussion for the attainment of biological concepts. Plans for the activity phase are given as laboratory exercises included in the text and as laboratory blocks, which are longer and may be chosen for an in-depth exploration of a fundamental topic.[2] Equally important to the inquiry approach is the guided discussion, designed to help direct the thinking of the student as he attempts to see how a scientist might approach the unraveling of various unsolved problems and to become better able to react scientifically to many new problems.[3] This

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[1] Bentley Glass, High School Biology, Blue Version, The Laboratory, Part One, 1960, p. ix.

[2] BSCS, Laboratory Blocks in Teaching Biology, BSCS Special Publication No. 5 (Boulder: University of Colorado, 1964), p. 4.

[3] Alfred S. Sussman, A Laboratory Block, Microbes: Their Growth, Nutrition and Interaction (Boston: D. C. Heath and Company, 1964), p. 18.

particular function is promoted through the use of "Invitations to Inquiry" as follows:

> An investigator was interested in the conditions under which seeds would best germinate. He placed several grains of corn on moist blotting paper in each of two glass dishes. He then placed one of these dishes in a room from which light was excluded. The other was placed in a well-lighted room. Both rooms were kept at the same temperature. After four days, the investigator examined the grains. He found that all the seeds in both dishes had germinated.
>
> 1. What interpretation would you make of the data from this experiment? Do not include facts that you may have obtained elsewhere, but restrict your interpretation to those from this experiment alone.
> 2. What factor was clearly different in the surroundings of the two dishes? In view of your answer, remembering that this was a deliberately planned experiment, state as precisely as you can the specific problem that led to this particular plan of experiment.
> 3. In view of the problem you have stated, look at the data again. What interpretation would you make?
> 4. Granting that light is not necessary for the germination of the corn seeds, different amounts of light may speed up or slow down germination. How might the experimenter check on this possibility?
> 5. Now that you have learned to test for the role that light plays in seed germination, plan an experiment in which you test the effect of temperature on seed germination.[1]

The BSCS also makes extensive use of visual aids[2] as a supplementary approach to convey the methods of inquiry.

In addition to introducing a new teaching approach, the BSCS also presents a modern content which attempts to reflect the present state of biological knowledge.[3] Indeed, with the development of biochemistry and biophysics, biology has entered the era of the molecular level, which has helped

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[1] Schwab, *op. cit.*, pp. 57-59.

[2] "BSCS Single Topic Films," *BSCS Newsletter*, No. 32, p. 9.

[3] "Inquiry Slides Series," *BSCS Newsletter*, No. 36, p. 7.

to uncover hidden biological problems. As a result, not only has more new knowledge been discovered, but also many older ideas have necessarily been redefined. Thus, our organized knowledge about living things has undergone a reformation. This reshaping is recognized in the BSCS materials, which shift the amount of emphasis placed on various levels of biological organization. The three BSCS versions themselves differ in the changed emphasis on different levels. The following figures illustrate the variation in the BSCS materials and the distribution of the different levels of organization in the BSCS materials and in traditional texts. (See Figures 3 and 4.)

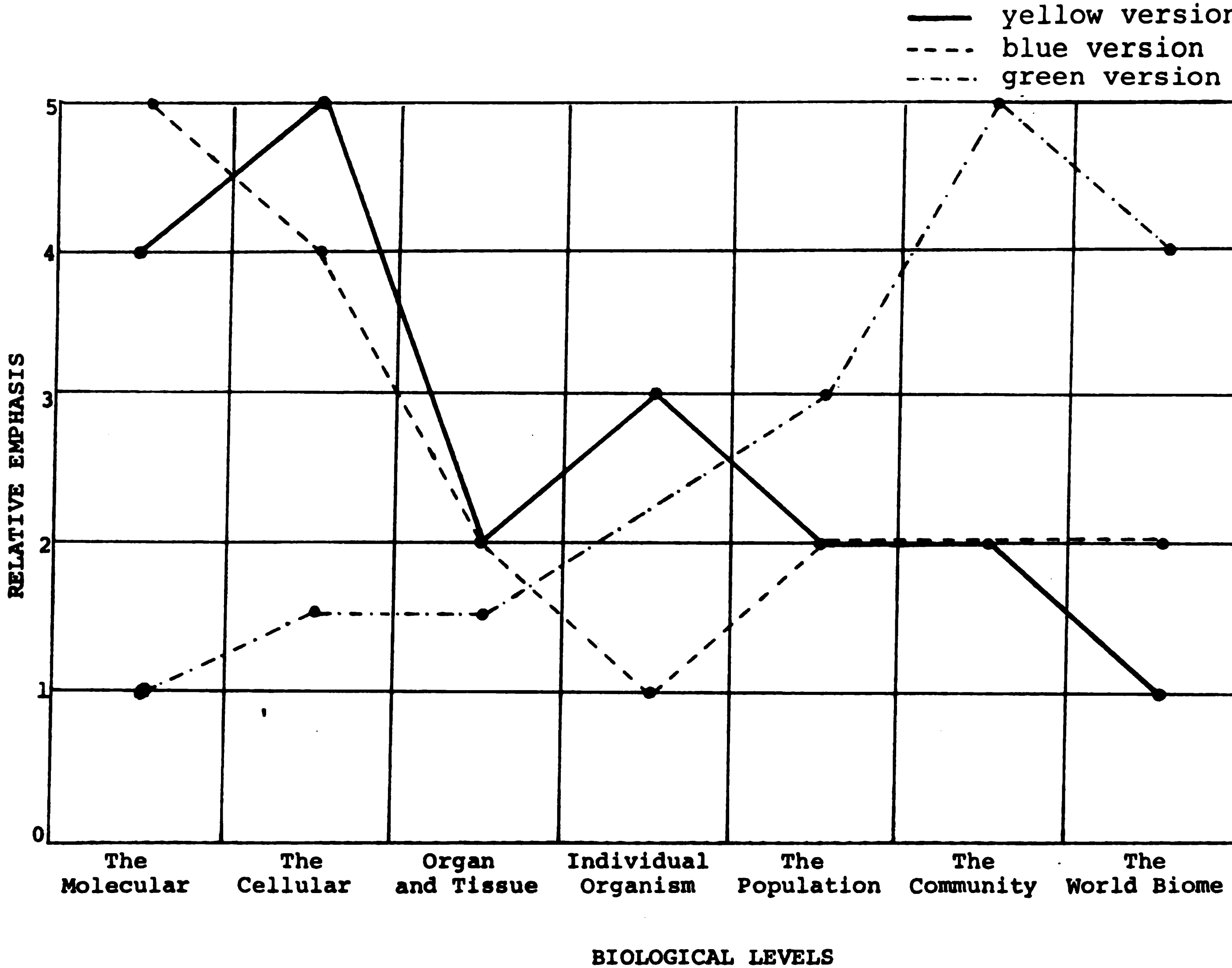
In conclusion, a new content of biology curriculum is developed on the basis of various conceptual themes. The new content represents a shift of emphasis on levels of biological organization. In addition, the BSCS materials place great emphasis on producing a laboratory program that emphasizes the inquiry approach as a means to increase participation and to promote thinking ability.

The departure from common biology teaching represented by the BSCS approach requires necessary teacher training; this will be dealt with in the next section.

Teacher Preparation

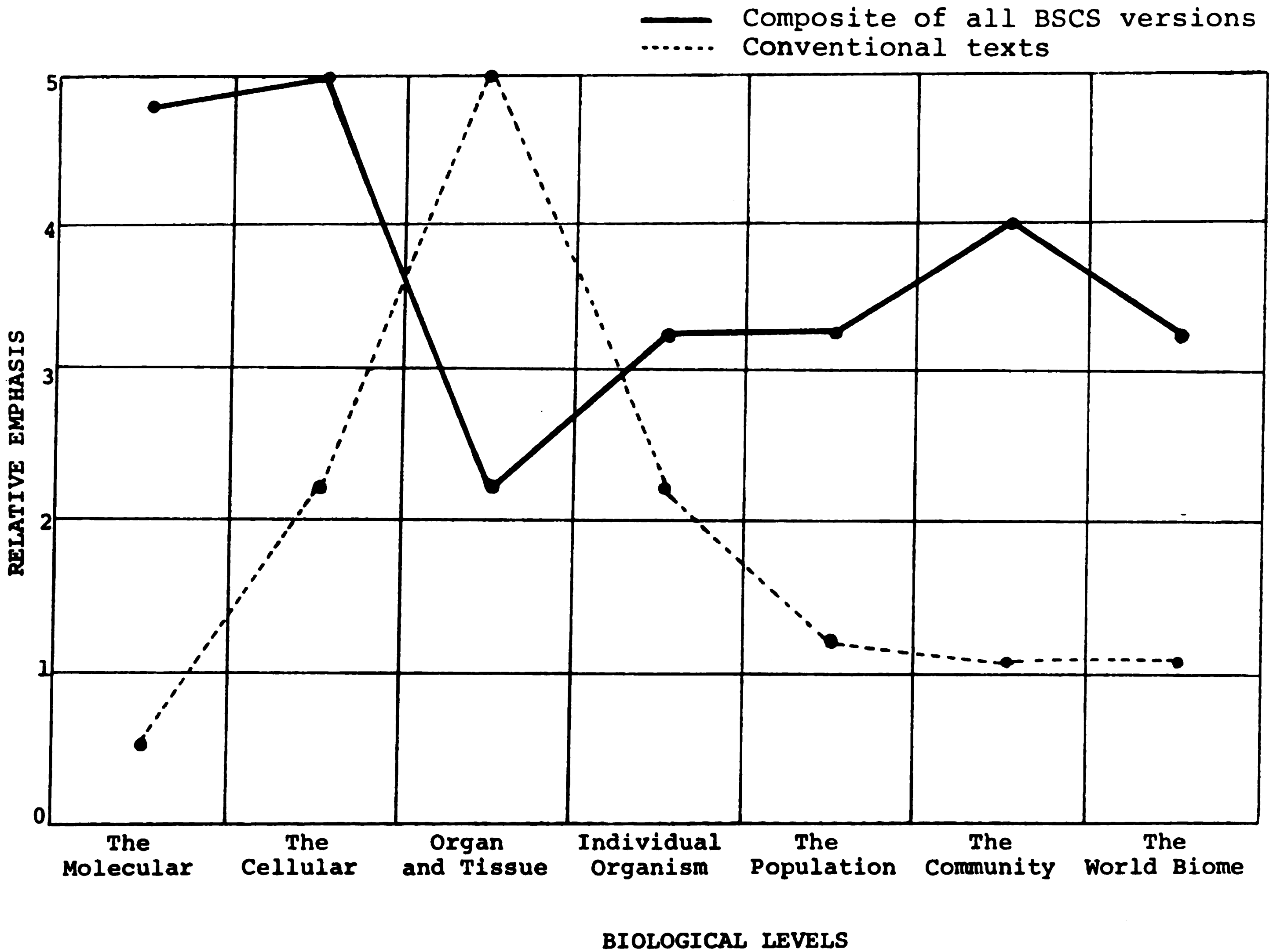
The BSCS Training Programs

Parallel to the development of new materials, the preparation of biology teachers is also an integral part of



Source: Joseph J. Schwab, The Biology Teacher's Handbook (New York: John Wiley and Sons, Inc., 1963), pp. 14-18.

Figure 3.--Different emphasis in the BSCS materials.



Source: Joseph J. Schwab, The Biology Teacher's Handbook (New York: John Wiley and Sons, Inc., 1963), pp. 14-18.

Figure 4.--Distribution of levels of organization in the BSCS and the traditional materials.

the BSCS project. Such preparation is imperative, since the BSCS has introduced a new teaching technique and a modern body of biological knowledge involving background in various disciplines that are not included in the traditional texts and may not have been included in the teacher's academic preparation. The primary concern has largely been dedicated to in-service training to update the content knowledge of present science teachers who plan to implement this new curriculum.[1]

Several studies have been conducted, and their findings indicate that to achieve the optimum effectiveness in teaching these materials, attention must be given to BSCS philosophy, strategies, and techniques.[2] Along the same line of thought, Schwab expressed the belief that:

> The notion of coverage, of conveying the current knowledge of a field which was once the essence of science teaching is called into question. It means that authoritative possession of a body of knowledge about a subject matter is no longer enough to qualify men as the best teachers of science. It means that the education of the science teacher must be something more than, perhaps something different from the inculcation of

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[1]BSCS, <u>BSCS Materials for Preparation of In-Service Teachers of Biology</u>, BSCS Special Publication No. 3, ed. by Ted F. Andrews (1964), pp. 9-68.

[2]Lehman W. Barnes, "The Nature and Extent of Laboratory Instruction in Selected Modern High School Biology Classes (unpublished Ph.D. dissertation, The University of Texas, Austin, 1966); Leonard H. Kochendorfer, "A Comparative Study of the Teaching Rationale and Methods of High School Biology Teachers Using Different Curriculum Materials" (unpublished Ph.D. dissertation, The University of Texas, Austin, 1966).

> conclusions, training in ways and means to pass them on. . . .[1]

"Something different," according to Schwab, implies the inquiry approach, which has been suggested as important to any training program:

> The primary objective of any training program (pre- and in-service) must be to develop a dedication to the investigation and inquiry approach in teaching biology.[2]

Behaviors to be performed as indicative of inquiry activities are also recommended:

1. An increased use of questions and a reduction in expository remarks.
2. Stating hypotheses and participating in suggesting experiments to test the hypotheses.
3. Criticizing experiments.
4. Drawing conclusions that are tentative rather than final or absolute.
5. Increased expression of observations regarding phenomena and events.[3]

In short, inquiry plays a central role in teaching modern biology. Thus, it has been suggested that in any training program, whether it be pre- or in-service, science

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[1] J. J. Schwab, "Inquiry, The Science Teachers and the Educators," The School Review (Summer, 1960), p. 180.

[2] BSCS, New Materials and Techniques in the Preparation of High School Biology Teachers, BSCS Special Publication No. 6, ed. by Glen E. Peterson (1969), p. 97.

[3] Ibid.

teachers must grasp the real significance of the process of inquiry by active involvement in the use of the laboratory "as the heart of the investigative approach leading to inquiry teaching." The pattern of inquiry developed by the BSCS places major emphasis on asking a "right question" in a given situation.

The CUEBS Training Program

In the same movement for reform, in 1963, the Commission on Undergraduate Education in Biological Sciences (CUEBS) was organized. As its name implies, the functions of the Commission were described as follows:

> The primary concern of the Commission is to help close the gap between the recent major advances in biological research and the content of undergraduate courses in biology. Consequently, the initial emphasis has been on courses and curriculum improvement and modernisation.[1]

Hence, the Commission arranged a number of conferences of biologists representing all types and sizes of universities from all regions of the country, and delineated areas of biological education in which CUEBS could help with improvements. The pre-service aspects of a teacher training program are found in almost all college and university curricula. As a result, a total program for the pre-service preparation of secondary school teachers was

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[1]Ted F. Andrews, CUEBS and the Preparation of Biology Teachers, CUEBS Publication No. 13, October, 1965, p. 1.

suggested, which encompassed two concentrations: the biology core and the professional educational area.[1]

The biology core constitutes the basic academic requirement in biology, involving a body of knowledge essential for all students majoring in biology. It has generally been contended that:

> All students specializing in biology, including potential teachers, would be expected to take the same core. . . . Specialisation beyond the core will differ, depending upon the professional goals of students.[2]

However, a single pattern for the biology core content was not identified.[3] Instead, in 1967, the Commission identified important trends in organizing the biology core:

> First, increasing emphasis is being put on preparation in mathematics, physics, and chemistry to allow the introduction of more sophisticated quantitative material and symbolic analysis into undergraduate biology instruction.
>
> Second, emphasis is increasing on the molecular and cellular levels of organisation at the relative expense of courses in morphology and systematics.
>
> Third, as an organizing principle in biology instruction the phylogenetic approach has been largely replaced by heredity, the cell, development, mechanisms of integration and evolutionary dynamics. In the process, there is less emphasis on the variety of organisms and more emphasis on general phenomena illustrated by the most appropriate organism.
>
> Fourth, there is a noticeable tendency toward greater emphasis on the biology of population, . . .

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[1]CUEBS, The Pre-Service Preparation of Secondary School Biology Teachers, CUEBS Publication No. 25, ed. by Addison E. Lee (June, 1967), p. 7.

[2]Benson E. Ginsburg, "Preparing the Modern Biology Teachers," Bioscience, XV, 12 (December, 1965), 769.

[3]Clifford Grobstein, "Defining the Core of a Science," The American Biology Teacher, December, 1966, pp. 804-808.

though not nearly so impressive quantitatively as the shift toward molecular and cell biology.[1]

Recently, serious attention is given to the ecological aspects of biology education, to cope with the growing environmental problems (pesticides, pollution, conservation).[2] Different areas are also suggested for inclusion as follows:

1. Molecular Topics. Elementary biochemistry, DNA structure and function, protein synthesis and regulation, properties of enzymes, biochemical synthetic pathways and energy metabolism.
2. Cellular Biology. Cell structure and function: gross and fine structure, physico-chemical organization, energetics, transport, mobility, homeostatic mechanisms. Cell growth and division. Cell differentiation and transformations; clonal variation and development. Evolutionary potential of cells; protistan evolution, origin of multicellularity.
3. Genetics. Mendelism--historical aspects: discovery and rediscovery of laws and modifications, linkage. Cytological basis of inheritance: meiosis, mitosis, non-disjunction. Molecular genetics: physical basis of the gene; gene action and regulation; homeostasis, integration in steady-state. Cytoplasmic inheritance: genes and development. Mutation: chromosomal aberration, effects of radiation. Genes in populations: evolution (speciation).
4. Developmental Biology. Plant and animal ontogeny (molecular to gross structural levels); experimental investigation of plant and animal development. Problems: Aggregation (molecular, cellular, multicellular). Directive aspects (induction, regulation, differentiation). Evolutionary aspects.
5. Organismic Biology. Structural and functional organization of selected higher plants and animals; a modern synthesis including (1) facts about the complications of organization of higher organisms, and (2) contemporary heuristic topics such as biological clocks, photo-induction of flowering, electrophysiology, neurosecretion, immune and self-recognition mechanisms.

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[1]CUEBS, Content of Core Curricula in Biology, CUEBS publication No. 18, 1967, p. 28.

[2]CUEBS News, VI, 3 (March, 1970).

6. Population and Community. Structure and dynamics. Environmental action and internal reactions; symbioses and competition. Energy flow, homeostasis and succession. Ecological aspects of natural selection.
7. Evolution. Present as a recurrent theme in each of the preceding. In most, cores will also receive independent, synthetic treatment as well.[1]

Emphasis on levels may be different, depending upon the institutional capabilities. All biology majors, irrespective of their professional intentions, are expected to be exposed to the same core, which is extended over a minimum of two years.[2]

Biology is taught with the conviction that it has relevance throughout the student's life.[3] Nevertheless, the theoretical structure in which concepts, generalizations, and theories are emphasized involves some arbitrary selection, which makes it always insufficient and inadequate. Hence, the need was felt to develop attitudes toward the certainty of data, the utility of science, the real meaning of scientific hypothesis, and the strengths and limitations of the scientific approach. These attributes are associated "more with the process of science, with its modes of generation, than with its theoretical structure."[4] On the other

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[1]Thomas S. Hall, "Core Studies for Undergraduate Majors," Bioscience, XIV, 8 (August, 1964), 27-28.

[2]Content of Core Curricula in Biology, op. cit., p. 31.

[3]C. E. Holt, P. Abramoff, L. V. Wilcox, Jr., and D. L. Abell, "Investigative Laboratory Program in Biology," Bioscience, XIX, 12 (1969), 1105.

[4]Ibid.

hand, in identifying the functions traditionally assigned to the laboratory, illustration, technique training, developing appreciation for biology and for living things, and stimulating discussion,[1] it is imperative to suggest that "the best use of the laboratory in undergraduate instruction is to engage the student in the process of active investigation."[2]

CUEBS analyzed the existing undergraduate programs, and found that the investigative role is almost universally neglected. Consequently, guidelines for an investigative laboratory were proposed for those attempting to teach investigation, and had the following characteristics:

> 1. Students are made aware from the beginning that the purpose of the course is to engage them in an investigation of their own choosing.
> 2. The laboratory begins with a series of activities which are carefully designed to prepare the student for investigative activities. During this stage, students are introduced to both cognitive and manipulative [activities] which can be used in the investigative process. This initial phase may benefit from the use of film loops, guided readings, audio-tutorial exercises, "dry" laboratories, tours of research and library facilities, programmed instruction, open-ended exercises, and inquiry role techniques. This phase of the course ends when the student has developed sufficient competence and confidence to identify a problem and design an attack on it. The length of this phase varies with ability of the students involved and the subject area and level in which the course is offered.
> 3. In consultation with the teacher, each student formulates a problem and investigative procedure for resolving it. Frequently, written or oral proposals are submitted for criticism by the instructor and

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[1] *Ibid.*, p. 1104.

[2] *Ibid.*

other students. Problem selection is, of course, limited by the natural constraints of available time, space, equipment, and supplies.

4. Experimental and observational work is carried out over a period of time sufficiently long that experiments can be repeated and the direction of the work can be modified if necessary. It is not unusual for students to make use of physical and human resources outside both the course and the college during this phase of the program.
5. The laboratory terminates with the submission of written and/or oral reports by each student.[1]

Laboratory activities are presumably incorporated within the curriculum structure, but college instructors are urged to give greater emphasis to the laboratory--not in the old style of making the laboratory a set of exercises with low priority, but rather with major emphasis on student activity so that, as Murray said, "the laboratory has become a sole entity unto itself."[2]

Since curricular reorganization was already active in the secondary schools through the advent of BSCS, an immediate need to revise their curricula faced the colleges. Evidence of change toward the adoption of the core program was reported in curricular revision of forty-seven colleges and universities throughout the United States.[3] Although the pattern of an investigative laboratory engages students in a research-type situation that requires much of their

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[1]CUEBS, The Laboratory: A Place to Investigate, Publication No. 33, ed. by John W. Thornton (April, 1972), p. 27.

[2]Darrel L. Murray, "The Laboratory: A Place for Investigation," CUEBS News, VI, 2 (December, 1969), 4.

[3]"The Ever-Changing Curriculum," CUEBS News, V, 3 (February, 1969), 1-13.

time and energy, as well as making extra demands on faculty and the physical facilities, such efforts have been made at several institutions, and the results have been reported with much enthusiasm and satisfaction.[1] Students in these investigative laboratory programs expressed the feeling that ". . . the most significant aspect of this whole experience was the challenge of selecting and formulating a problem of interest."[2]

Biological Science in Southeast Asia

Report of the First Asian Regional Conference on School Biology

Stimulated by curriculum improvement projects, especially BSCS and the Nuffield project, a number of countries in Asia have become interested in adapting these materials for use in school biology curricula. The Philippines and Taiwan are the countries in Southeast Asia that have led in the adaptation of the BSCS versions for school programs. Since these first efforts, there has been a growing tendency to revise school biology programs in different countries in Southeast Asia.

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[1]John W. Thornton, "An Investigative Laboratory in Cell Biology," CUEBS News, VII, 1 (October, 1970), 7-10; Robert G. Thompson, "The Investigative Laboratory in an Introductory Course for Nonscience Majors at Marquette University," CUEBS News, VII, 3 (February, 1971), 5-8; Ann M. Lacy and Helen B. Funk, "The Investigative Laboratory in an Introductory Biology Course," CUEBS News, VII, 2 (December, 1970), 12-15.

[2]Darrel L. Murray, "The Investigative Laboratory: Selection and Formulation of a Problem," CUEBS News, VI, 5 (June, 1970), 8.

This Conference gave representative leaders an opportunity to share their experiences with those who were attempting to initiate curriculum revisions.

The report of the Conference consists of three sections:

1. A survey of biology teaching in high schools in participating countries, prepared by each country.
2. Contribution papers of the project leaders on BSCS, Nuffield, and the adaptation projects of the first countries in Asia.
3. Reports of the five major discussion sections. One of these sections was related directly to teaching methods and teacher training. The recommendations from this discussion are of importance to this study, and were as follows:

> 1. Biology must be taught as a science, thus scientific inquiry should be the basis of this teaching.
> 2. A background knowledge of chemistry, physics and other related sciences is necessary for teaching modern biology properly.
> 3. Practical applications of biological principles should be brought to focus.
> 4. Local materials and specimens should be utilised as much as possible.[1]

Reports of the SEAMEO Regional Seminar on Science and Mathematics

In 1967, the First Regional Seminar including members of six countries (Indonesia, Malaysia, Philippines,

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[1]Asian Association for Biology Education, First Asian Regional Conference on School Biology (Philippines: Science Education Center, University of Philippines, December, 1966), p. 307.

Singapore, Thailand, and the Republic of Vietnam) was convened to discuss and identify problems and needs relating to the teaching of science and mathematics within the participating countries in Southeast Asia, and concurrently to obtain information and current data on scientific projects already under way.[1] Five subject areas were included: biology, chemistry, elementary science, mathematics, and physics. In each subject area, four functional areas were taken into consideration, involving:

1. Training to include both content and methodology of science teaching.
2. Research and development of new syllabi, instructional materials, teaching aids, and other equipment.
3. Special services to include improvisation of equipment, development of manuals, etc.
4. Development of an information center for relevant data on science and mathematics.

Specific problems in each functional area were identified by participants in a working group; their main task was to produce "a definitive set of plan projects," including a series of suggested courses for SEAMEO, which would enable them to plan a long-range training program for key personnel from the participating countries. The basic objectives of the SEAMEO training program were stated as follows:

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[1]Southeast Asia Ministers of Education Organisation (SEAMEO), Report of the SEAMEO Regional Seminar on Science and Mathematics, September 12-14, 1967, p. 1.

1. To train leaders and teacher-training specialists in secondary school education who can play primary roles in introducing modern secondary education methods and appropriate content in science to their countries and prepare teachers to implement new methods and curricula that will meet their national needs.
2. To provide them with sufficient experiences in the study, selection and adaptation of content and activities in secondary science; a good understanding into modern child-learning theory and a clear understanding of the modern methods of teaching and evaluating secondary science in order that they can play a key role in curriculum development.
3. To enable them to obtain a sound understanding of the urgent needs of the secondary schools in terms of the professional preparation of prospective teachers for modern science teaching in order to perform leadership role in pre-service training of science teachers.
4. To provide them with opportunities to study different types of in-service training activities that have been carried out in different countries, their merits and shortcomings and other associated activities such as improvisation of science apparatus and use of local materials.
5. To expose participants to modern science education philosophies, methodology, content as exemplified in a variety of curriculum materials from various countries and regions.
6. To conduct and present the course in a manner that should serve as a model of the way that participants should carry out when implementing national programs on their return.[1]

In the biology subject area,[2] the courses were designed to acquaint participants with the BSCS materials and the Nuffield series, in order to develop an understanding of modern biology education. In addition to promoting

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[1]Southeast Asia Ministers of Education Organisation (SEAMEO), _Proceedings of the Seminar on Science Curriculum Development and Evolution in Southeast Asia: Final Report_, Vol. I (September, 1970), p. 5.

[2]_Report of the SEAMEO Regional Seminar_, _op. cit._, p. 36; _Seminar on Science Curriculum Development and Evolution_, _op. cit._, pp. 77-84.

the pedagogical skills of biology teaching, opportunities were provided to select and practice investigative experiments underlying the modern teaching approach that characterizes the current trend of biology education.

As a result of these conferences, there is a growing awareness of the modern teaching projects in biology education in Southeast Asian countries, and some implementations of modern biology teaching have been stimulated by SEAMEO in-service training efforts. On the other hand, no attempt has been made to modify the pre-service training of secondary school biology teachers in accordance with these new developments.

Conclusions

The review of the literature on biology education at the secondary school and college level in the United States revealed the following:

1. There is a reduction in morphology and taxonomy content.
2. There is a reduction in the "rhetoric of conclusions."
3. There is increased preparation in mathematics, physics, and biochemistry as biology has become a more experimental and quantitative science involving these related sciences.
4. There is an effort to organize biology content around unifying conceptual schemes and principles.

5. There is a shift of emphasis on levels of biological organization, with preference on the molecular, cellular, and population levels.
6. There is a greater emphasis on the process of science as a method of teaching and learning biology.
7. There is a need to provide an organization of the biology curriculum that secures continuity and cohesion.

Southeast Asia shares with the United States a great interest in new trends to improve biology education. In Vietnam, action in response to new developments has been evidenced by the restating of the biology teaching objectives for secondary schools and by providing more laboratory work even though this still continues traditional functions.

This chapter has made an effort to describe carefully the laboratory programs developed by BSCS and CUEBS for teaching and training in modern biology. Although the two programs are different in form, both aim at teaching the processes of science, since it is by the processes that scientific knowledge grows, and scientific facts are generated at such a rapid rate that they alone cannot sustain a functional program. Furthermore, the processes of science are becoming an integral part of teaching and learning modern science.

Summary of the Chapter

In this chapter were presented trends in modern biology education in terms of changes in content, instructional methods and the teacher preparation in the United States, and an investigation of biology education in Southeast Asia in the face of these new developments. The review of the literature on biology education serves as a useful guideline to develop a modified scheme for Vietnam that (1) moves forward from present teaching as described in Chapter II, (2) focuses on local situations as described in Chapter III, and (3) incorporates the findings of this chapter to produce a modern biology education program to meet the needs of people for literacy and facility with the processes of science. This program, of necessity, will be structured differently--in both content and methods--from previous efforts.

CHAPTER V

THE PROPOSED BIOLOGY TRAINING PROGRAM FOR SECONDARY SCHOOL TEACHERS OF THE MEKONG DELTA REGION

Introduction

This chapter contains a description of a proposed biology training program for secondary school teachers of the Mekong Delta region. The first part of the chapter is concerned with the essential foundations for an effective training program in biology. Taking into account findings of the previous chapters, the second part of this chapter contains a proposal of a four-year program and its components.

Considerations Regarding the Needs for the Training Program of the Mekong Delta Region

The 1970 revision of the Vietnam biology curriculum suggested specific changes in the content and teaching methods for biology as follows:

A. The program should

- provide essential knowledge of the living world.
- help learners to observe and to think scientifically.
- encourage the application of learning experiences to everyday life.

B. Methodology should change

- to delete dependence on memorization methods.
- to increase illustration of lectures with charts, models, or experiments.
- to stimulate student participation in discussions.
- to maximize the practice of laboratory work.
- to utilize recent scientific discoveries in instruction.

The new emphasis was on developing critical and scientific thinking as the major outcomes of the learning process. It was recognized that this would require a different pattern of teacher preparation and a new set of instructional practices.

The analysis of the biology training program at Cantho University indicated that it does not meet the objectives which lead to the modern teaching approach, demanded by the new developments in biology education. In fact, the review of modern trends in biology education revealed that emphasis should be on teaching concepts and principles, not on the acquisition of factual information, and on teaching the processes of science. This latter idea may be achieved by engaging the student in different steps which lead toward the solving of problems by doing. Approaching the doing of science requires the acquisition of certain skills, among which is skill in the use of the library. Thomas Kirk mentioned three functional roles of the library in an investigative laboratory: (1) exploration of scientific literature, (2) reservoir of information, and (3) choice for appropriate techniques and methods through prior works.[1]

The analysis of the local community led to the formulation of a functional goal for biology teacher training. To serve the local community, one must be able to use its great potential in agriculture and fisheries. Teachers need to understand the geographic location, the natural resources, and the human resources which support the economic development of the Mekong Delta region. Public health problems have been a continuing threat to the labor force, primarily because of the lack of education for the common man. The training program for biology teachers should include a response to their needs and demands.

The proposed program is an attempt to realize the needs and the demands of the Mekong Delta region and to bring them together in a training program for prospective biology teachers which embodies a modern training pattern. How will the objectives of the training program for the Mekong Delta region be structured? How do the generally accepted factors of curriculum planning (such as breadth, depth, and sequence) apply to teacher training in biology? The following section deals with these questions.

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[1]Thomas G. Kirk, "The Role of the Library in an Investigative Laboratory," in <u>The Laboratory: A Place to Investigate</u>, <u>op. cit.</u>, pp. 122-123.

Clarification of Objectives of the Proposed Program for Secondary School Biology Teachers in the Mekong Delta Region

The objectives of the training program for secondary school biology teachers in the Mekong Delta region may be described as follows:

1. To provide prospective teachers with a basic level of biological literacy necessary to teach for intelligent citizenship in today's world.

2. To provide prospective teachers with an understanding of the broad conceptual schemes of modern biology that are essential for the growth of biology teaching and self-development.

3. To develop in prospective teachers biological concepts that have appropriate implications to their immediate environment.

4. To give prospective teachers an understanding of the interrelatedness of biology and other sciences and mathematics, and to demonstrate that biology is no longer a descriptive science but is quantitative.

5. To develop in prospective teachers critical thinking and problem-solving ability by providing them with a knowledge of scientific methods and skills.

Considerations of Breadth, Depth, and Sequence

This section presents guidelines and recommendations regarding the breadth, depth, and sequence suggested by various authorities for a teacher education program. These suggestions will be used as a framework to design a balanced training program in biology.

It has been recommended that:

1. The preparation of prospective biology teachers should comprise approximately one-half of the four-year college program (equivalent to a minimum of 140 semester hours). This preparation should include the teaching area and the related sciences that are considered most applicable to the major.[1]

2. Teachers should attain broad minimum competencies in several fields of science.[2] The needed breadth can also function to stimulate students[3] and help them understand the interrelationships within and among various fields and the significance of science as a human activity.[4]

For biology majors, breadth implies:

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[1]Alfred B. Garrett, _et al._, "Recommendation for the Preparation of High School Teachers of Science and Mathematics," _School Science and Mathematics_, XLIX, 4 (April, 1969), 283.

[2]National Association of State Directors of Teacher Education and Certification, _Guidelines and Standards for the Education of Secondary School Teachers of Science and Mathematics_ (Washington, D.C.: American Association for the Advancement of Science, 1971), p. 13.

[3]John S. Richardson, _et al._, "The Education of Science Teachers," _Rethinking Science Education_, The 59th Yearbook of NSSE (Chicago: The University of Chicago Press, 1966), p. 266.

[4]National Association of State Directors of Teacher Education and Certification, _Guidelines for Preparation Programs of Teachers of Secondary School Science and Mathematics_ (Washington, D.C.: American Association for the Advancement of Science, 1961), p. 4.

2a. One year of college physics together with one year of college chemistry, including an introduction to organic chemistry and biochemistry,[1] with an emphasis on biomolecules and metabolic activities of living things.

2b. At least the minimal mathematical competencies[2] of an acquaintance with basic principles of differential and integral calculus, and some knowledge of probability and statistics.[3] Any mathematics course for biology teachers should have appropriate application to biology, so that the mathematical preparation can become a functional tool that will enable biology teachers to guide students to formulate and to explain scientific phenomena.

3. These supporting courses should be included as early in the pre-service program as possible, and courses in education should be deferred until the foundation in the subject-matter field is well-established.[4]

4. Prospective secondary school biology teachers should have a college major (i.e., a minimum of twenty-four semester hours) in the biological sciences, including one year of general biology.[5]

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[1] Ibid., p. 9.

[2] Guidelines and Standards, op. cit., p. 19.

[3] Ibid.

[4] William M. Merrill, et al., "Recommendations: Academic Preparation of Secondary School Earth Science Teachers," Journal of Geology Education, XIV, 1 (February, 1966), 31.

[5] "Problems Related to the Teaching of Biology," American Biology Teacher, XVII, 1 (January, 1955), 42.

5. The biology program should provide opportunities for prospective teachers to gain insight into the intellectual and philosophical nature of biology.[1] A biology teacher should thoroughly understand the history of his subject, its philosophical nature, its conceptual structure, and its investigative methods.

6. "The depth of training for a biology teacher must be sufficient for him to understand the nature of the discipline, its substance and its methods. He must have some insight into the problems at the frontiers of biology and possess an understanding of the events that caused these problems to emerge. His training must be such that he is qualified to do graduate work in biology and to participate in curriculum improvement in biology."[2]

Proposed Program

This proposed program is designed in accordance with the framework laid out above, and encompasses 40-45 semester credits of the total preparation in biology during the four-year training program.

The pattern of the proposed program will be structured as shown in Tables 13 and 14.

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[1] *Ibid.*, pp. 16 and 21.

[2] Paul DeHart Hurd, "The Education of Secondary School Biology Teachers," *American Biology Teacher*, XXIV (May, 1962), 329.

Table 13.--Requirements of the proposed program for secondary school biology teachers of the Mekong Delta region.

Courses	No. of Credits
Biology: Introductory Biology	10 cr.
Advanced Biology	30-35 cr.
	40-45 cr.
Related Sciences:	
Physics: Mechanics, Heat & Thermodynamics and Quantum Physics	12 cr.
Chemistry: General and Organic Chemistry	8-9 cr.
Biochemistry	5 cr.
Mathematics: Algebra, Calculus, Statistics, and Probability	11 cr.
	36-37 cr.
Other Program Components:	58-64 cr.
Professional Preparation	
Courses in General Education other than Biology, Mathematics, Physics, and Chemistry	
Electives	

Table 14.--The proposed four-year program for secondary school biology teachers of the Mekong Delta region.

First Year

First Semester		Second Semester	
Physics: Mechanics	4cr	Biology: Diversity in Biology	
Chemistry: General Chemistry	5cr	Physics: Heat & Thermodynamics	4cr
Mathematics: Algebra	3cr	Chemistry: Organic Chemistry	3-4cr
		Mathematics: Calculus	3cr
Other	6cr	Other	3cr
	18cr		17-18cr

Second Year

First Semester		Second Semester	
Biology: Unity in Biology	5cr	Genetics	4-5cr
Physics: Quantum Physics	4cr	Entomology	3cr
Biochemistry	5cr	Human Nutrition	3cr
Math: Statistics & Probability	5cr		
Other	2cr	Other	6-8cr
	21cr		16-19cr

Third Year

First Semester		Second Semester	
Microbiology	5cr	Parasitology	3cr
Aquatic Biology	5cr	Soil Biology	4cr
		Fishery Science	4cr
Other	6-8cr	Other	6cr
	16-18cr		17cr

Fourth Year

First Semester	Second Semester
Electives and other to total 30-35 credits	

Description of Biology Courses in the Training Program

The biology program for prospective secondary school teachers in the Mekong Delta will consist of two units: Introductory Biology and Advanced Biology.

Introductory Biology

Introductory Biology attempts to provide a broad perspective and to allow subsequent courses to be intermediate. Students will be exposed to the breadth of biological topics; recent developments will be included, since biology is a dynamic and growing field.

This introductory program involves two sequential teaching subunits--the Diversity in Biology and the corresponding Unity of Biology--and will be taken for two consecutive semesters of five credits each.

General topics to be included in the two subunits are outlined as follows:

Only the Introductory program will be given in detail, with suggested readings of parallel research included under each topic. This has a primary importance in an attempt to introduce to the students how biological knowledge is generated, to point which direction it is going, and finally to make use of primary and secondary source materials for obtaining information. Nevertheless, the selection is almost entirely confined to the *Scientific American* and *Science* magazines. The reason for this is that these magazines may possibly be more accessible back home; on the other hand, the language is written for the general population.

First Course: Diversity in Biology.--Comparative morphology and physiology, adaptation and ecosystems.

Topics to be included.--Comparative morphology and physiology of representative organisms from each of the major groups of plants, animals, and microorganisms. Adaptation. Ecosystems: Food chain--Energy flow--Biogeochemical cycles--Environmental influences--Biological clocks.

Suggested parallel readings of related research.--

Arnon, Daniel I., "The Role of Light in Photosynthesis," Scientific American, CIII, 5 (November, 1960), 104.

Eiseley, Loren, "Charles Darwin," Scientific American, CXCV, 2 (February, 1956), 62.

Holt, S. J., "Food Resources of the Ocean," Scientific American, CCXXI, 3 (September, 1969), 178.

Irving, Lawrence, "Adaptations to Cold," Scientific American, CCXIV, 1 (January, 1966), 94.

Levine, L. P., "The Mechanism of Photosynthesis," Scientific American, CCXXI, 6 (December, 1969), 58.

Mazia, Daniel, "How Cells Divide," Scientific American, CCV, 3 (September, 1961), 100.

Wessell, Norman K., and Rutter, William J. "Phases in Cell Differentiation," Scientific American, CCXX, 3 (March, 1969), 36.

Wigglesworth, V. B., "Metamorphosis, Polymorphism, Differentiation," Scientific American, CC, 2 (February, 1959), 106.

Woodwell, G. M., "Toxic Substances and Ecological Cycles," Scientific American, CCXVI, 3 (March, 1967), 24.

Wynne-Edwards, V. C., "Habitat Selection," Scientific American, CCXI, 2 (August, 1964), 68.

Second Course: Unity in Biology.--Cellular, molecular, and genetic biology.

Cellular Biology

Topics to be included.--Fine structure and function of the cell, transfer of energy within cells, enzymes and enzymatic actions.

Suggested parallel readings of related research.--

Blair, P. V., et al., "Isolation of the Unit of Electron Transfer," Biochemistry, XX, 576 (1963).

Brachet, J., "The Living Cell," Scientific American, CCV, 3 (September, 1961), 50.

Chance, B., and Williams, G. R., "The Respiratory Chain and Oxidative Phosphorilation," Adv. in Enzymology, XVII, 65 (1956).

Green, David E., "The Mitochondrion," Scientific American, CCX, 1 (January, 1964), 78.

Lehninger, A., "How Cells Transform Energy," Scientific American, XXV, 3 (September, 1961), 62.

Robertson, David, "The Membrane of the Living Cell," Scientific American, CCVI, 4 (April, 1962), 64.

Molecular Biology

Topics to be included.--Nucleic acids: Discovery--Nucleotides as basic units of nucleic acid--Biological functions of nucleic acids. Watson and Crick Model of DNA molecules--Replication of DNA. Biological code--The synthesis of proteins.

Suggested parallel readings of related research.--

Allfrey, V. G., and Mirsky, A. E., "How Cells Make Molecules," Scientific American, CCV, 3 (September, 1961), 74.

Benzer, Seymour, "The Find Structure of the Gene," Scientific American, CCVII, 1 (July, 1962), 70.

Boyes, B. C., "The Impact of Mendel," Bioscience, February, 1966, p. 85.

Crow, James F., "Ionizing Radiation and Evolution," Scientific American, CCI, 3 (September, 1959), 138.

Hotchkiss, Rollin D., and Weiss, Esther, "Transformed Bacteria," Scientific American, CXCV, 5 (November, 1956), 48.

Sager, Ruth, "Genes Outside the Chromosomes," Scientific American, CCXII, 1 (January, 1965), 70.

Wills, Christopher, "Genetic Load," Scientific American, CCXXII, 3 (March, 1970), 98.

Advanced Biology

Advanced Biology provides intensive training in those areas which were previously determined to underlie the socio-economic needs of the Mekong Delta. Three areas--health, agriculture, and fishery--have been selected as the themes of concentration, upon which subsequent courses will be developed in relation to modern biological information. More depth will be expected in these courses.

The advanced training is comprised of 30-35 semester hours; there are eight courses to be developed under the three themes, namely: Microbiology, Parasitology, Human Nutrition, Genetics, Entomology, Soil Biology, Aquatic Biology, and Fishery Science.

This advanced unit follows the introductory sequence with three consecutive semesters, and will be accomplished by the end of the junior year. This unit allows the student greater flexibility in his course sequence. In fact, it is perceived that Microbiology should precede Parasitology and Soil Biology; likewise, Aquatic Biology should be taken before Fishery Science. Therefore, possible combinations in this unit are significant.

General topics for each course are described as follows:

Microbiology

Principles of microbiology: nutrition, growth, distribution, and activities of microorganisms

Organisms causing infections commonly found in the Mekong Delta region: skin rupture, ringworms, diarrhea, tuberculosis.

Causes of infections

Methods of controlling microorganisms

Parasitology

Characteristics of parasites: general consideration of parasitism, kinds of parasites, form and life cycle of parasites.

Sources of infections: polluted water, waste disposal, food, soil

Means of transmission

Methods of control

Human nutrition

Metabolic machinery of the body

Nutrient requirements of the body

Significance of vitamins in metabolism

Significance of minerals in metabolism

Importance of balanced diets for human health

<u>Genetics</u>

Principles of genetics: hybrids of desired characteristics

Breeding of crops:

Development of rice varieties and other crops

Development of better-producing crops that are resistant to plant diseases and insects, and have better flavor and even higher protein content

<u>Entomology</u>

Biological relationships of insects

Insect behavior, ecology, development, and metamorphosis

Important insect pests in the Mekong Delta

Control of insects (related to health, also)

<u>Soil Biology</u>

Structure and properties of soils

Fauna and flora in soil. Significance of soil microorganisms in nitrogen fixation in relation to soil productivity. Supply of higher plants to soil fertility

Fertilizers and crops. Use of "natural" sources of green manures as fertilizers

Biological effects of pesticides and other chemical spraying in soils

Aquatic Biology

Freshwaters

Physical features: floods, silt load, chemistry

Biology: emphasis on freshwater plankton, fish fauna in natural waters of rivers, swamps, crustaceans

Marine waters

Estuary habitats: characteristics and biology

Shore and coastal habitats: characteristics and biology including marine plankton and its seasonal distribution. Value of seaweed as human food and manure

Fishery Science

Fishing catch: seasonal variation in species

Conservation of young fish

Diseases of fish: microbial diseases, parasitic diseases, and toxic accumulation due to chemically polluted bodies of water

Fish processing and industry

Laboratory Approach

In allowing 40-45 semester hours for the entire biology program, the laboratory practices are actually included and may involve laboratory work and/or field experiences, which could be assigned from 1-2 semester credits for each course.

The nature of the laboratory work is to engage students in the process of science. First, students participate in the search for an answer to a given problem. Simple experiments of this kind could be adopted from the BSCS materials so that common laboratory techniques necessary for each unit can be acquired concurrently. This initial stage will be concluded by designing a project under teacher guidance, in which the student will choose a topic and devise a suitable technique according to the availability of facilities (references, specimens, equipment, time, or any improvisation, if necessary).

Summary of the Chapter

In this chapter, a biology training program for secondary school teachers in the Mekong Delta region was proposed. This program is relevant to modern trends in biology education, and meets the needs of economic development and social problems in this particular region.

The chapter included the following components: (1) considerations of needs for the biology training program of the Mekong Delta region, (2) a statement of objectives, (3) assumptions for planning an effective biology curriculum, and (4) the proposed program, including its requirements, the proposed four-year program, description of training courses, and the laboratory approach.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provides a general summary of the study, the conclusions drawn, and recommendations related to the implementation of the proposed biology teacher training program in the Mekong Delta region.

Summary of the Findings

The purpose of this study was to construct a biology teacher training curriculum for the Mekong Delta region, with the major emphasis on the organization of courses and experiences within the biological sciences.

First, an analysis of current practices at Cantho University was made, since this is the only higher education institution offering a biology teacher training program that provides service for the whole region. The analysis was made with reference to the new set of Vietnam school biology objectives developed in the 1970 curriculum revision. The revision was made in response to new developments in biology education, and called for changes in both content and teaching methods, resulting in a demand for a different pattern of teacher training.

An intensive study of international trends in modern biology education and in the training of biology teachers suggested guidelines for planning a curriculum which would have "modern" characteristics, both in content and instructional methods. This modern teaching and training approach was oriented to include:

1. a reduction in the amount of emphasis on morphology and taxonomy.
2. a reduction in the "rhetoric of conclusion" style.
3. increased preparation in related sciences such as chemistry, physics, and mathematics.
4. an emphasis on teaching concepts and principles rather than on mere information accretion.
5. a shift of emphasis toward discussions on the molecular, cellular, and population levels.
6. a greater emphasis on the process of science and the associated process skills.

The curriculum is also designed to have a "local" characteristic, that is to organize a body of biological knowledge in relation to the immediate environment. Analysis of the socio-economic factors of the Mekong Delta suggested the needs and the demands upon which the planning should be concentrated so that the selected biological knowledge would have direct application to people in this region. Three important areas were selected for emphasis: public health, agriculture, and fisheries.

Conclusions

Taking into consideration the modern biology approach, as well as the needs and demands of the post-war economic development and social problems of the Mekong Delta region, the training program was formulated in accordance with the following parameters: (1) The training should be a four-year program; (2) Biology teachers should have a broad minimum competency in related sciences; (3) Sufficient training should be provided in the student's major area to permit an understanding of the nature of the discipline, its substance, and its methods; and (4) The plan of the program should emphasize the inquiry/laboratory approach to learning the processes of science.

The proposed program for secondary school biology teachers in the Mekong Delta region consists of three components:

Biology	40-45 credits
Related Sciences	36-37 credits
Other Program Components	58-64 credits

The biology program includes two units: Introductory Biology and Advanced Biology. The Introductory Biology program provides breadth of biological topics, and Advanced Biology is intended to give depth on the topics organized under the three themes or concentrations: public health, agriculture, and fisheries. Course descriptions for each unit are also included. The necessary laboratory approach, which attempts to teach for the processes of science, is also described.

Implications for Education

Recommendations for the implementation of the proposed program can be classified into four categories: recommendations on location, on instructional materials, on staff formation, and on administration.

Recommendation on Location

Currently, in the Mekong Delta there are two institutions in addition to Cantho University--Hoa-Hao university (two years old) and My-tho Junior College (in the process of being established). Cantho University is considered to be the best equipped in terms of staff, buildings, library, and laboratory facilities. The university also has a teaching staff, who have recently received training in several countries in different areas of biology, biochemistry, geology, physics, agriculture, and library management. Finally, the science laboratories are being equipped with assistance from foreign aid to make them the most modern laboratories in Southeast Asia.

Recommendation 1: On the basis of the situation, it seems advisable to initiate the proposed program at Cantho University.

Recommendations on Instructional Materials

Some research has been conducted on science instruction in the Mekong Delta (some of which was cited in Chapter III), and other investigations are presently in process (The United Nations' Agricultural Project for the Mekong Delta Region, An Investigation of Herbicide Residues on Crops and Human Health). This work is partially available in published form, and the rest exists as unpublished papers scattered throughout Vietnam and in foreign countries. In order to make the findings useful, they should be gathered and classified under one bibliography.

Recommendation 2: A systematic effort should be made to gather related research documents and to prepare a bibliography and reprint as necessary.

More research, even in the areas covered, is needed; the information should be supplemented by further research in the Mekong Delta. Such research should be encouraged by providing grants to the university and to qualified students. Funds might come from the government, foreign aid, or local firms and businessmen whose activities are affected by conditions in the Mekong Delta.

Recommendation 3: A program should be undertaken to seek support for and encourage new research on biology education and biological conditions in the Mekong Delta.

Living organisms are numerous and their population distribution varies with the seasons. Therefore, a laboratory approach should be devised according to the seasons to make use of local living organisms for teaching and research, as there is no access to a biological supply house. Emphasis also should be placed on equipment that can be purchased locally or improvised if necessary.

Recommendation 4: A laboratory sequence should be developed, according to the seasonal distribution of living organisms, and dependent on locally available equipment.

Recommendations on Staff Formation

The presently available staff is indeed insufficient to accomplish the full development of a program in biology education. Possible measures which could be undertaken are providing grants or scholarships for graduates who are interested in the described areas, inviting researchers who have done research in related fields to lecture or to give seminars on their research problems, or hiring temporary staff from other universities and foreign countries, whereever possible.

Recommendation 5: Ways to supplement the present staff with researchers and other university faculty should be sought, at least as a temporary measure.

Recommendation 6: In the long run, permanent staff must be developed by attracting graduate students to undertake further study in selected areas.

Recommendation on Administration

To organize materials, plan for the implementation of the proposed program, and later provide continuous assistance to in-service school teachers on innovations, simple equipment, and implementation, and to encourage project work for school students, a science center available to the Faculty of Pedagogy should be established. The center can provide resources and facilities for the long-range redevelopment of biology education.

Recommendation 7: Establishment of a science center for Cantho University should be given high priority.

Problems for Further Research

A massive curriculum change such as that proposed will undoubtedly produce changes at the secondary school and college levels. The most significant problems for research may be classified into four groups:

1. Studies should be conducted to estimate the cost and benefit relationships for the implementation of the proposed program. It is important to be able to weight expenditures for planning the new courses, hiring and training new staff,

and developing the instructional materials against how many people may benefit from the program.

2. Follow-up studies should be conducted to determine the impact of the proposed program on the socio-economic structure of the Mekong Delta region: improvement of public health (evidence of decrease of infectious diseases, water-borne diseases, water pollution), rise in income, and efficiency of agricultural production or fisheries management.

3. Studies should be conducted to investigate obstacles (administrative, political, religious) which hamper the implementation of the proposed program.

4. Research should be conducted to investigate the teachers' performance in classrooms, students' interest in biology, and behavior in comparison to the old curriculum. Pretests and posttests could easily be conducted to yield insight into this change.

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