AN INVESTIGATION OF THE ATTITUDES TOWARD SCIENCE AND SCIENCE TEACHING OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A major goal for science education is the development of a positive attitude toward science. Students' attitudes toward science may be more important than their understanding of science, since their attitudes determine how they will use their scientific knowledge (Ramsey, 1969). In discussing attitude, Sax (1974) stated that the learning of almost any intellectual task carries with it elements of interest and attitude which may either facilitate or hinder additional learning. Ragan (1960) pointed out that the importance of attitude in facilitating learning is that childrens' attitudes affect what they learn, what they remember, and what they do. Wood et al. (1968) considered the importance of favorable attitudes toward science and scientists for two main reasons. First, students' attitudes influence, to a considerable degree, their learning of science and their use of the scientific information. Second, the possession of a favorable attitude toward science is an important characteristic of a scientifically literate person. In developing positive attitudes of students toward science, science teachers should possess attitudes toward science themselves.

Human beings acquire attitudes and beliefs at an early age. These feelings are later manifested in terms of interests, motivation, and an increasingly complex value system. As students experience a school subject such as science, success or failure tends to shape their feelings

toward the subject. Eventually, students develop their feelings about themselves, abilities to accomplish specific tasks in school, and their overall self-worth. The pre-formed attitudes of students are further affected by the characteristics of their teachers (Simpson, 1978).

Lawrenz (1975) investigated the relationship between selected science teacher characteristics (knowledge of subject matter and teaching methods, experience, professional self-improvement, type of learning environment programs, and attitude toward science) and student outcomes (achievement and attitude). The investigation shows that the relationship between science teacher characteristics and student outcomes existed with a correlation coefficient of .61.

Attitudes of a teacher toward a subject area and the teaching of that subject are certainly important variables to consider when describing a teacher's function within the classroom (Earl and Winkeljohn, 1977). In discussing a teacher's attitude, Carin and Sund (1964) made this statement:

> One of the most important aspects of the problem solving approach to children's development in scientific thinking is the teacher's attitude. The teacher is the person who can make the emphasis in elementary science one of inquisitiveness and eagerness for finding answers . . . (p. 57).

Todd (1958) identified the teacher's attitude as a significant deterrent to effective science teaching. He pointed out that teachers who enter the profession with attitudes that interfere with their abilities and desires to teach science effectively, unwittingly transmit these attitudes to their students. Todd's statement was supported by Stollberg (1969) when he stated that teachers who have negative or neutral attitudes toward science can either avoid the teaching of science or risk passing these attitudes along to their students.

Hone and Carwell (1969, p. 24) stated "children's built-in radar is fine-tuned to their teacher's feelings about science." This statement was supported by Washton (1971) that students imitate attitudes of their teachers toward science.

Since the teacher generally determines what is taught and how much the student should participate in a classroom activity, the teacher's attitude not only influences the student's attitude but also greatly affects the student's learning experience (Piper, 1977).

Teachers' attitudes toward science and science teaching are considered a vital factor in influencing their students' performance in science. In order to teach science effectively, science teachers should not only be knowledgeable and skilled in science, but should also have positive attitudes toward science and science teaching.

Rationale for the Study

During the past decade, a dramatic change in science eduation took place in Thailand: great emphasis was placed on expansion of science education throughout the school levels. It was recognized by the national authorities that an understanding of science and its process is a necessity for Thai children, because the world today is being increasingly influenced and sometimes dominated by science and technology. Since science plays a major role in influencing present societies and shaping the future, the children may not be able to have full and abundant lives in the future without an understanding of science and its processes. Therefore, in 1976, the science curriculum in Thailand was revised.

The success of the new science curriculum project depends on the usefulness of materials produced and the capabilities of the science

teachers who use them. It is the responsibility of the teacher training program to prepare effective science teachers. Science teachers should be prepared with skill and knowledge in science, and should possess positive attitudes toward science and science teaching. The investigator, a science teacher trainer, saw the need to investigate attitudes of Thai preservice elementary science teachers toward science and science teaching. This study has been conducted for that purpose.

Statement of the Problem

A review of the literature indicated that variables stand out as being important considerations to investigate if science education programs are goint to be implemented that will improve attitudes and educate science teachers to teach science effectively. Six control variables were investigated existent relationships between the variables and attitudes of Thai preservice elementary science teachers toward science and science teaching. The control variables were:

1. Preservice elementary science teachers' sex
2. Type of secondary school (public or private)
3. Geographic cultural pattern (North, South, Central, or Northeast)
4. Location of student teaching (rural or urban)
5. Number of male and female college science teachers (majority male or female), and
6. Cooperating teachers' sex.

The six control variables were included in this study based on the following assumptions.

1. It is a common belief that males excel in science and are more

interested in science than females. Thus, it was assumed that in Thai society, male and female preservice elementary science teachers differ in their attitudes toward science and science teaching. This study seeks to investigate whether a relationship exists between attitudes of Thai preservice elementary science teachers toward science and science teaching, and sex.

2. Schools in Thailand can be grouped in two types: public schools (local, municipal, and government schools), and private schools. Private and public schools are different in some aspects even though they both are under the control of the Ministry of Education. Since the government finances public schools, textbooks, science materials, and the area of emphasis in science are the same for all public schools. Private schools have the right to select their own textbooks and science materials. Therefore, the students graduating from public schools and private schools are likely to have experience of different science programs. It was assumed that preservice elementary science teachers graduating from public schools and those graduating from private schools differ in their attitudes toward science and science teaching. This study seeks to investigate whether a relationship exists between the public/private type of secondary school and attitudes of Thai preservice elementary science teachers toward science and science teaching.

3. Environment is one of the factors affecting the way in which children develop. Baez (1976) stated that children's actual developments are strongly affected by environmental factors. Children are immersed in a value system associated with traditional, cultural, and moral rules which may help or hinder the pursuit of scientific knowledge. Traditional and cultural upbringing are sometimes associated with taboos. The

children may never be allowed to practice some of the processes and theories of science along lines which go counter to the taboos of their cultural upbringing.

The people of Thailand differ in geographic background: ethnic origin, culture, and language. Based on the historical background and geographic cultural patterns of Thailand (Appendix A), preservice teachers in four regions are immersed in different geographic cultural patterns. It was assumed that Thai preservice elementary science teachers in the four geographic regions differ in their attitudes toward science and science teaching. The study seeks to investigate the possible relationship between the geographic cultural patterns and attitudes of Thai preservice elementary science teachers toward science and science teaching.

4. In Thailand, most teacher training colleges do not have practice schools. Preservice elementary science teachers are sent out to teach in local schools. Some schools are located in urban areas and some are in the rural areas. A rural school is generally ill equipped, having inadequate resources or facilities needed for effective teaching. Preservice teachers who are assigned to teach in rural schools will have to identify the rural resources for enriching school programs. The science activities ought to be so organized as to mobilize the available resources. The urban schools can provide the more and better facilities needed for science teaching. From this point of view, preservice teachers who student teach in urban schools experience situations different from those student teaching in rural schools. It was assumed that preservice elementary science teachers student teaching in urban and rural schools differ in their attitudes toward science and science teaching. This study

seeks to investigate whether a relationship exists between the urban/rural location of student teaching and attitudes of Thai preservice elementary science teachers toward science and science teaching.

5. As stated by Todd (1958), science teachers transmit their attitudes toward science to students. Given that a relationship existed between sex and attitude toward science/science teaching, then it might be assumed that Thai preservice elementary science teachers having the majority male/female college science teachers differ in their attitudes toward science and science teaching. This study seeks to investigate the possible relationship between the number of majority male/female college science teachers and attitudes of Thai preservice elementary science teachers toward science and science teaching.

6. During student teaching, preservice teachers are under the supervision of both college supervisors and cooperating teachers. Preservice teachers work closely with cooperating teachers in classrooms, where the philosophy and methods of teaching science are applied. These preservice teachers' attitudes toward science and science teaching might be influenced by their cooperating teachers. Assuming that a relationship exists between sex and attitude toward science/science teaching, then it might be further assumed that preservice elementary science teachers under supervision of male and female cooperating teachers differ in their attitudes toward science and science teaching. The study seeks to investigate the relationship between cooperating teachers' sex and attitudes of Thai preservice elementary science teachers toward science and science teaching.

Based on the investigator's assumptions, answers to the following specific research questions were explored, and the corresponding null

hypotheses were stated:

Qu_{1-a} - Do Thai preservice elementary science teachers possess positive or negative attitudes toward science?

H_{01-a} - There is no significant difference in the proportion of Thai preservice elementary science teachers responding with a positive or negative attitude toward science.

Qu_{1-b} - Do Thai preservice elementary science teachers possess positive or negative attitudes toward science teaching?

H_{01-b} - There is no significant difference in the proportion of Thai preservice elementary science teachers responding with a positive or negative attitude toward science teaching.

Qu_{2} - Is there a relationship between attitudes of Thai preservice elementary science teachers toward science and science teaching?

H_{02} - There is no significant relationship between the sets of rank-ordered scores in attitudes of Thai preservice elementary science teachers toward science and science teaching.

Qu_{3-a} - To what degree does a relationship exist between sex and attitudes of Thai preservice elementary science teachers toward science?

H_{03-a} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between male and female Thai preservice elementary science teachers.

Qu_{3-b} - To what degree does a relationship exist between sex and attitude of Thai preservice elementary science teachers toward science teaching?

H_{03-b} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between male and female Thai preservice elementary science teachers.

Qu_{3-c} - To what degree does a relationship exist between attitudes of male Thai preservice elementary science teachers toward science and science teaching?

H_{03-c} - There is no significant relationship between the sets of rank-ordered scores in attitudes of male Thai preservice elementary science teachers toward science and science teaching.

Qu_{3-d} - To what degree does a relationship exist between attitudes of female Thai preservice elementary science teachers toward science and science teaching?

H_{03-d} - There is no significant relationship between the sets of rank-ordered scores in attitudes of female Thai preservice elementary science teachers toward science and science teaching.

Qu_{4-a} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the private/public type of secondary school?

H_{04-a} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers graduating from private and public secondary schools.

Qu_{4-b} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science

teaching and the private/public type of secondary school?

H_{04-b} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers graduating from private and public sceondary schools.

Qu_{5-a} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns?

H_{05-a} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers from four geographic cultural patterns.

Qu_{5-b} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the four geographic cultural patterns?

H_{05-b} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers from the four geographic cultural patterns.

Qu_{6-a} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the urban'rural location of student teaching?

H_{06-a} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers student teaching in urban and rural schools.

Qu_{6-b} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the urban/rural location of student teaching?

H_{06-b} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice teachers student teaching in urban and rural schools.

Qu_{7-a} To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the number of majority male/female college science teachers?

H_{07-a} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers having majority male and female college science teachers.

Qu_{7-b} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers?

H_{07-b} - There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers having majority male and female college science teachers.

Qu_{8-a} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and cooperating teachers' sex?

H_{08-a} - There is no significant difference in the proportion of upper

quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers under supervision of male and female cooperating teachers.

Qu_{8-b} - To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the cooperating teachers' sex?

H_{08-b} - There is no significant difference in the proportion of upper quartile or lower quartile responses toward science teaching between Thai preservice elementary science teachers under supervision of male and female cooperating teachers.

Purpose of the Study

The purpose of this study is to investigate: (1) current attitudes of Thai preservice elementary science teachers toward science and science teaching, (2) the existence of relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching, (3) the existence of relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching, and the following six control variables:

1. Preservice elementary science teachers' sex
2. Public/private type of secondary school
3. North/South/Central/Northeast geographic cultural pattern
4. Rural/urban location of student teaching
5. Number of majority male/female college science teachers
6. Cooperating teacher's sex.

The intention of this study is to provide information to those who are involved in developing and improving science teacher education

programs. Additionally, the results of this study will, hopefully, assist Thai educators, curriculum specialists, and teachers become aware of preservice elementary science teachers' attitudes toward science and science teaching.

Basic Assumptions

For the purpose of this study, the following assumptions are made:

1. Attitudes toward science and science teaching are measurable.

2. Attitudes toward science and science teaching of Thai preservice elementary science teachers can be inferred from responses on the Science Teaching Attitude Scales.

3. Translation of the Science Teaching Attitude Scales into Thai language did not alter their meaning.

4. Sampling of eight teacher training colleges in clusters provided representative samples of the target population in the 36 Thai teacher training colleges.

Limitations of the Study

There are certain limitations which may influence the results of this study:

1. The subjects of this study were limited to 376 preservice teachers from eight teacher training colleges.

2. The teacher training colleges involved in the study were not randomly selected.

3. The Science Teaching Attitude Scales were field tested by the developer in the United States. This instrument may not be appropriate for use in Thailand.

Definition of Terms

For the purpose and the understanding of this study, the following frequently used terms are defined:

Science refers to a subject matter in the curriculum of a school or organized body of knowledge.

Attitude toward science refers to Thai preservice teachers' emotionalized feelings for or against science. For the purpose of this study, attitude toward science is inferred through the responses on the Science Teaching Attitude Scales (Moore, 1973).

Positive attitude toward science refers to a score of 60 or above in the assessment of attitude toward science on the Science Teaching Attitude Scales (Moore, 1973).

Negative attitude toward science refers to the score below 60 in the assessment of attitude toward science on the Science Teaching Attitude Scales (Moore, 1973).

Attitude toward science teaching refers to how Thai preservice teachers feel about science teaching, how they perceive the role of science teacher, and whether they agree on current thinking in science education. For the purpose of this study, attitude toward science teaching is inferred through the responses on the Science Teaching Attitude Scales (Moore, 1973).

Positive attitude toward science teaching refers to the score of 45 or above in the assessment of attitude toward science teaching on the Science Teaching Attitude Scales (Moore, 1973).

Negative attitude toward science teaching refers to the score below 45 in the assessment of attitude toward science teaching on the Science

Teaching Attitude Scales (Moore, 1973).

Upper quartile attitude response refers to the score above the first quartile.

Lower quartile attitude response refers to the score below the third quartile.

Teacher training college refers to an institution where the teacher preparation takes place. The institutions admit the students graduated from high school. A two-year program for elementary and lower secondary teacher training (grades 1-9) and a further two-year program for higher secondary teacher training (grades 11-12) are provided.

College science teacher refers to the science teacher who teaches general science, chemistry, biology, and physics in a teacher training college.

Preservice elementary science teacher refers to a prospective science teacher in the senior year of a two-year program for elementary and lower secondary teacher training (grades 1-9).

Cooperative teacher refers to a teacher who is regularly assigned to teach in a public school in urban/rural area to whom a preservice teacher is assigned.

Urban student teaching refers to practice teaching in the municipal area (population 70,000 or more) where a teacher training college is located.

Rural student teaching refers to practice teaching in the rural area (population less than 70,000) where a teacher training college is at the center.

Geographic cultural patterns refer to the four regions, North, South, Central, and Northeast Thailand that display different cultural backgrounds in the population.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A review of the literature related to this study is presented under five headings: (1) nature of attitudes, (2) attitude toward science and scientific attitude, (3) factors influencing attitudes of inservice and preservice teacher toward science, (4) sex differences in science achievement, and (5) teacher education programs in Thailand.

The following descriptors were used in an Educational Resources Information Center (ERIC) search from 1966 through 1979, which yielded several references: (1) Teacher Education, (2) Science Education, (3) Preservice Teachers, (4) Scientific Attitudes, (5) Science Teachers, (6) Elementary School Science, (7) Attitude Tests, (8) Cooperating Teachers, (9) Changing Attitudes, (10) Student Teaching, (11) Preservice Education, and (12) Doctoral Thesis. Information was also compiled from professional journals, books, documents, and other publications.

Nature of Attitudes

What is atttude? The term "attitude" is defined by authors in many ways. Attitude is seen as a generalized response to a particular group, institution, concept, or object along a favorable-unfavorable dimension (Sax, 1974). Falk (1971) defined an attitude as a settled

behavior or manner. To Falk, an attitude represents both an orientation toward or away from some object, concept, or situation, and a readiness to respond in a pre-determined manner to these factors. As described by Allport (1935), attitude is a mental and neutral state of readiness organized through experience and exerting a direction and dynamic influence upon the individual's response to all objects and situations with which it is related. Shaw and Wright (1967) agreed with Allport when they suggested that attitudes are not innate but learned, and are developed through many learning experiences. Sorenson (1964) described an attitude as a particular feeling about something. Attitude, therefore, involves a certain way in situations which involve that "something," whether it be a person, idea, or object. It is partically rational and partially emotional, and is not inherent but acquired by the individual.

How individuals feel or what they believe cannot be measured directly, but may be inferred from their behavioral manifestation through the use of questions, or by obtaining the individual's expressed reaction to statements. Green (1954) defined attitude as being observable and measurable. He described attitude as a psychological construct, or latent variable, inferred from observable responses to stimuli that are assumed to mediate consistency and covariation among these responses.

Ebel (1938, p. 5) defined attitude as a stabilized set of disposition: "A stabilized mental set which expresses itself in a tendency to react to any member of a class of stimuli in the same general way."

According to Bybee (1974), attitude is a predisposition of behavior toward an object or referent in the subject's environment. These objects can be almost anything; it can be either concrete or abstract,

but usually has social importance in terms of education, science, minority groups, sex, or oneself.

Discussing the role and characteristics of attitude, Haney (1964) wrote the following statement:

> Attitudes regulate behavior that is directed toward or away from some objects or situations or group of objects or situations. Attitudes have emotional content and vary in intensity and generality according to the range of objects or situations over which they apply (p. 33).

Attitude is important, as is pointed out by Wethington (1966) what individuals are and what they may become, whether they succeed or fail, achieve satisfaction or not, approach their potential or allow their talents to remain undeveloped or underdeveloped, depends on the attitudes they have acquired.

Sax (1974) presented five characteristics of attitudes: (1) direction, (2) intensity, (3) pervasiveness, (4) consistency, and (5) salience. The direction of an attitude refers to whether an individual views objects with favor or disfavor. Attitudes differ in intensity. One individual might have a slightly favorable attitude toward science, whereas another may have a highly positive one. The third characteristic of attitudes--pervasiveness--is the range of an attitude. One person might like to study only scientific theory, whereas another may like almost everything concerning science.

Consistency is the fourth distinguishing feature of an attitude. Some people respond to an attitude scale in a perfectly consistent manner, whereas others express both positive and negative attitudes toward the same subject. An individual might agree to a scientific theory but at the same time may also be superstitious. Salience is the degree of the spontaneity to express an attitude. It can be measured only if an

attitude is expressed without probing of any sort, such as from observations and interviews during which the person has the opportunity to express an attitude independently.

Bloom, et al. (1964, p. 36) in discussing the process by which an attitude is acquired, stated that attitudes emerge first at the level of "willingness to respond" and become increasingly internalized in the learner through the stages of "satisfaction in response," "acceptance of value," "preference for a value," "commitment," and "conceptualization of a value." At this last stage, the learner is able to "see how the value relates to those he has already held or to new ones that he is coming to hold."

Attitude Toward Science and Scientific Attitude

The term "attitude" can have many interpretations in science education. Ramsey and Howe (1969) indicated that the development of attitudes in science teaching includes both the development of "scientific attitude" and "attitude toward science." In discussing the difference between the development of a scientific attitude and an attitude toward science, they noted:

> It is difficult to pinpoint exactly what is meant by development of attitudes, if the development of a scientific attitude is meant, then characteristics to be evaluated include habits of accuracy, intellectual honesty, openmindedness, seeking cause- and effect-relationships, and the ability to suspend judgment. If the development of positive attitudes toward science or scientists is meant, then the feelings, opinions, emotions, and appreciation of our students must be evaluated . . . (p. 66).

In discussing the importance of a scientific attitude, Noll (1936) stated that the possession of a scientific attitude by people is of great importance in helping them understand and properly interpret scientific

knowlege and methods concerning our daily lives.

Sears and Kessen (1964, p. 4) presented the views of the American Association for the Advancement of Science (AAAS) Commission on Science Education: "The first task and central purpose of science education is to awaken in the child, whether or not he will become a professional scientist, a sense of joy, the excitement, and the intellectual power of science."

Since the importance of attitude toward science (discussed in Chapter I page 1 of this study) and scientific attitude have been recognized and developed through science education, the term "attitude toward science" and "scientific attitude" must be clearly and concisely defined so that they can be effectively developed and evaluated. Several attempts have been made to establish the definitions of these two terms of attitudes. The investigator will now review some of these definitions.

The term "attitude toward science" as defined by Allport (1967) is:

> . . . the positive or negative feelings, opinions, beliefs in and about, and appreciation which individuals have formed as a result of interacting directly or indirectly with various aspects of scientific enterprise, and which exert a direct influence on their behavior toward science (p. 1).

Another definition of attitude toward science was offered by Dutton and Stephens (1963, p. 43): "Attitude toward science refers to how an individual feels about science--an emotionalized feeling for or against science."

Gardner (1975) defined attitude toward science as being concerned with the emotional reactions of students toward science. A person's attitude toward science is regarded as a learned disposition to evaluate in certain ways the objects, people, actions, situations, or propositions involved in the learning of science.

Scientific attitudes are simply elements in the philosophy of science. They are assumptions and rules of practice which have been formulated consciously and deliberately (Lampkin Jr., 1938). The sound definition of the scientific attitude should be a "part of the progressive science teacher's equipment" (Ebel, 1938, p. 1). The imparting of the scientific attitude is considered to be a "fundamental obligation of science teaching" (Ebel, 1938, p. 1).

In discussing science teaching in an elementary school, Heffernan (1965) asked the question, "Do our elementary schools really teach science?" She commented that in answering this question one must consider scientific attitude. Heffernan defined scientific attitude as:

> . . . one of intellectual curiosity and wonderment, of eagerness to discover and accept reality, of open-mindedness and tolerance, of humility toward truth, of withholding judgement in the absence of evidence, and of considering all judgments and conclusions as tentative and subject to revision in the light of new or additional evidence (p. 32).

Moore and Sutman (1970, p. 86) defined scientific attitudes for the purpose of developing an instrument to assess them. Their definition of scientific attitudes includes both intellectual and emotional components. In explaining the distinction between these two components, Moore and Sutman said that intellectual attitudes are based upon some knowledge about the psychological object of the attitude, and emotional attitudes are based upon a feeling or emotional reaction to the psychological object of the attitude. Scientific attitude defined by Moore and Sutman (1970) is "an opinion or position taken with respect to a psychological object in the field of science."

In discussing scientific attitudes, Elbe (1938) suggested that since scientific attitudes have existed in the minds of outstanding men of science, attitudes can therefore be interpreted to foster scientific

achievement.

Among the presentations of the components of the scientific attitudes are those by Noll (1935), Haney (1964), Billeh and Zakhariades (1975), and Diederich (1967). The components of scientific attitudes found in the literature are: (1) open-mindedness, (2) curiosity, (3) rationality, (4) humility, (5) willingness, (6) intellectural honesty, (7) scepticism, (8) aversion to superstition, (9) liking for scientific explanations, (10) objectivity in gathering and interpreting data, (11) faith in the possibility of solving problems, (12) desire for experimental verification, (13) accuracy in all operations including calculation, observation and report, (14) habit of looking for true cause-effect relationships, (15) habit of suspending judgment, (16) habit of weighing evidence, and (17) habit of criticalness, including that of self-criticism or having a critical mind.

Billeh and Zakhariades (1975) identified the following six general components of scientific attitudes with specific behavior:

1. Rationality
    a. commitment of the value of rationality
    b. tendency to test traditional beliefs
    c. seeking for natural causes of events and identification of cause-and-effect relationships
    d. acceptance of criticalness
    e. challenge of authority
2. Curiosity
    a. desire for understanding new situations that are not explained by an existing body of knowledge
    b. seeking to find out the "whys" and "hows" of observed

phenomena

c. give emphasis on the questioning approach for novel situations

d. desire for completeness of knowledge

3. Open-mindedness

a. willingness to revise opinions and conclusions

b. desire for new things and ideas

c. rejection of singular and rigid approaches to people, things, and ideas

4. Aversion to Superstitions

a. rejection of superstitious beliefs

b. acceptance of scientific facts and explanations

5. Objectivity-Intellectual Honesty

a. demonstration of the greatest possible concern for observing and recording facts without any influence of personal pride, bias, or ambition

b. in interpreting results, does not allow any modifications according to present social, economic, or political conditions

6. Suspended Judgment

a. unwillingness to draw inferences before evidence is collected

b. unwillingness to accept as facts things that are not supported by convincing proof

c. avoidance of quick judgments and jumping to conclusions.

Factors Influencing Attitudes of Inservice and Preservice Teachers Toward Science

Considerable research has been done in the field of attitudes of inservice and preservice teachers toward science and science teaching. A number of variables have been used to study the influence on or the relation to teachers' attitudes toward science and science teaching. These variables are found to revolve around teachers' characteristics and experiences. The following variables were found in several studies: (1) personal characteristics (sex, age, and religious preference), (2) educational experiences (level of educational attainment, number of science courses, science methods courses, type of undergraduate institution attended, and elementary science program experienced), (3) professional experiences (teaching experience, grade level taught, and classroom organization). The results of some studies were found to be contradictory and some were found to be supportive.

One of the truisms of American culture is a masculine bias to science and technology (Shrigley, 1974). Several studies have been conducted to examine attitudinal differences in science between male and female teachers. Todd (1958) reported that female teachers demonstrated more negative attitudes toward science. It was suspected that this was due to the feeling that science was not suitable for females. A later study by Piper (1977) involving preservice elementary teachers supported Todd's conclusion. Piper reported a statistically significant difference in attitude between males and females toward science in high school prior to the science methods course. The females appeared to have more negative attitudes toward the science they remembered in high school than did the males, and these attitudes did not change following the methods course.

Shrigley and Johnson (1974) studied inservice elementary teachers and reported that there was a significant difference in attitude toward science between males and females. A contradictory result was reported by Shrigley (1974) in a study of preservice elementary teachers. Shrigley did not find significant sex differences in attitude toward science. Schwirian and Thompson (1972) also reported that no significant differences in attitude toward science were observed over time between male and female teachers. There appears to be no consistent agreement in the literature as to the existence of sex differences in attitude toward science.

In discussing a difference in attitude between older and younger elementary teachers toward science, Schwirian (1969) noted that increasing age is more likely to make a person less flexible and receptive to the rapid changes engendered by the activity of the scientific institution. Furthermore, the experience that the older teacher has had in the classroom as a science student is more distant than that of his younger colleagues. According to Schwirian, age is strongly related to attitude toward science. She reported that there was indeed a marked difference in the attitude between younger and older elementary teachers toward science. In her study, teachers 40 years of age and under demonstrated more favorable attitudes toward science. Shrigley and Johnson (1974) made a contrasting observation: the mean score of inservice elementary teachers with 40 years of age or older was higher but was not significantly so.

Schwirian (1969) reported in her study that there was no significant relationship between religious preferences (Catholic, Protestant, Jew, or other) and inservice elementary teachers' attitudes toward science.

However, Jewish teachers tended to express more positive attitudes toward science than either Protestant or Catholic teachers.

Wethington (1966), Gladstein (1967), and Butts (1970) all agreed that attitude develops as a result of previous experiences. The attitudes of students toward science is strongly influenced by their experiences with this subject beginning in the lower grades. In 1969, Barretto investigated the effect of educational experiences on the attitudes of preservice teachers toward science. It was reported that preservice teachers with the greater number of semester hours of college science responded with a more positive attitude toward science than those with fewer semester hours of college science. In another related study by Schwirian (1969), it was reported that there was a significant positive association between hours of college science and attitudes toward science among those teachers under 40 years of age. She also found that teachers with greater numbers of college science possessed a more positive attitudes toward science than those with fewer numbers of college science. The findings of Barretto and Schwirian are supported by Shrigley (1974) that the enrollment in more science courses affected the attitude toward science positively. Shrigley commented that more science courses may not always mean a more positive attitude toward science. In the implication of his study, Shrigley (1974) suggested that the finding does not necessarily imply that requiring prospective elementary majors to experience more high school science would result in teachers with a more positive attitude toward science. The finding could imply that enrollees in science education courses having more high school science courses would have a more positive attitude.

Butts and Raun (1969) reported a contrasting observation: teachers

who have had few or no formal science courses have more positive attitudes toward the impact of science, the impact of their teaching, and the impact of the processes of science.

Attempts to develop science skills and a favorable attitude toward science have led to a number of new science methods courses for preservice teachers (Thompson and Thomson, 1975). Several studies have been conducted to determine the effect of science methods courses on attitudes toward science. Strawitz (1976) used 82 elementary majors to assess the effect of an "activity-centered science methods course" on attitude toward science. Activities for the treatment group were drawn from ESS and SCIS. Strawitz found positive attitudes following the methods course and also found that participation in activities by the students with the children appeared to influence more positive attitudes.

Allison and Smith (1974) investigated preservice elementary teachers' attitudes toward science after participating in an "activity-oriented science methods course" using concrete experiences, instructor modeling, and field experiences. In addition, this science methods course was "competency-based." Allison and Smith reported that this science methods course developed positive attitudes toward science. Piper (1977) also found positive attitudes toward science following a similar methods course. She compared attitudes of preservice elementary teachers following participation in traditional and non-traditional science methods course. The results showed that preservice elementary teachers participating in non-traditional science methods courses (competency-based and field-oriented) developed more positive attitudes toward science than those who participated in traditional science methods courses (lecture-oriented).

Moore and Robards (1977) investigated the effect of a field-centered methods course as compared to a campus-centered methods course on preservice elementary teachers' attitudes toward science. The results showed that involvement in field experiences developed more positive attitudes toward science.

Riley (1979) compared the effects of hands-on versus nonmanipulative training in process skills on preservice elementary teachers' attitudes toward science and science teaching. It was reported that there was no significant difference in attitudes toward science and science teaching due to the effects of the treatment.

Attempts to develop positive attitudes toward science have also led to new science programs for inservice teachers. Pempek and Block (1973) investigated the effect of an inquiry-oriented science program on inservice teachers' attitudes toward science. It was reported that the experimental group exhibited statistically significant positive changes in their attitudes toward science.

Piper (1976) examined the effect of a televised science inservice program on attitudes of inservice teachers. The results indicated that inservice teachers' attitudes were improved toward science.

According to Shrigley (1974), a greater classroom involvement with the scientific enterprise possibly results in a more positive attitude toward science. Shrigley studied the effect of organized (time set aside regularly in the school timetable) and incidental elementary science programs on attitudes of preservice teachers toward science. It was reported that there was a significant difference in the mean scores between the two groups, with preservice teachers who were experienced in

an organized science program showed positive attitudes toward science.

Levels of educational attainment of inservice elementary teachers have been investigated as a factor influencing attitudes toward science. In 1969, Schwirian explored the effect of levels of educational attainment on inservice teachers' attitudes toward science. With age controlled, there was no significant association between highest academic degree held and attitude toward science. A similar result was reported by Rothmans et al. (1969).

Schwirian (1969) noted that elementary education requirements vary from one university to another. They differ with regard to type of school and the size of university. The larger colleges or universities have wider offerings and more stringent requirements in science and science-related fields than do small colleges. She suspected that a greater exposure to science may help produce more positive attitudes toward science. Schwirian investigated the relationship between type of undergraduate institution attended and inservice elementary teachers' attitudes toward science. She hypothesized that graduates of schools providing and requiring more science courses will graduate elementary teachers with more positive attitudes toward science and scientific instituions. The results of the study showed that the state college graduates scored statistically higher on attitude toward science than the liberal arts college graduates. Schwirian questions this:

> Is the difference in attitude toward science observed between state school graduates and liberal arts college graduates simply a matter of science requirements? Where does the difference lie - in sheer size? faculty attitude? or the general level of sophistication? (p. 209)

Schwirian (1969) believed that science teaching experience increases in science teachers the awareness of scientific endeavors and understanding

of science. Science teachers are offered opportunities to interact, explore, and manipulate science through science teaching. The opportunities of exposure to many varied experiences in science are believed to result in more skill and develop a more positive attitude toward science. Schwirian investigated the relationship between the years of teaching experience and the attitudes toward science of science teachers. She reported a significant relationship, but when age was controlled, the relationship was not found.

Butts and Raun (1969) reported that previous teaching experience of science teachers was not a significant contributor to a change in attitude. There was a wide range of teaching experiences represented, but there were no systematic trends observed.

Billeh and Zakhariades (1975) compared attitudes toward science between university seniors and science teachers. No significant difference was found. This outcome implies that teaching experience does not affect science teachers' attitudes toward science.

Smith (1971) reported a contrasting observation with preservice teachers. He held that the student teaching experience had a positive effect on the preservice teachers' attitudes toward biology and the inquiry approach.

Schwirian (1969) observed that female elementary teachers often leave their teaching profession because they want to devote time to caring for growing families. Some of these teachers return to the teaching profession five or ten years later. During their years away from school they become less familiar with new developments in science and science teaching. Schwirian suspected that those teachers may demonstrate less positive attitudes toward the scientific enterprise than teachers

who have remained actively engaged in the teaching profession. Schwirian compared the attitude toward science of teachers between "continuous teaching" and "interrupted teaching." It was reported that the nature of teaching experience (continuous or interrupted) was significantly related to teachers' attitudes toward science with age controlled. The "continuous teaching" teachers possessed more positive attitudes toward science than the "interrupted teaching teachers."

Shrigley and Johnson (1974) pointed out the possibility that teachers with a less favorable attitude toward science gravitated to the primary grades where they felt less threatened by science teaching. In a study involving inservice teachers, Shrigley and Johnson reported the lack of significant findings concerning attitudinal differences in science among K-3, 4-6, and 7-8 grade teachers. Schwirian (1969) agreed when she reported that teachers of lower grade levels did not hold less positive attitudes toward science than did teachers of higher grade levels.

Shrigley and Johnson (1974) stated that science is the most recent curricular area where instant expertise is expected. All of the science teachers in a departmentalized classroom are assumed to be "science specialists." They believed that teachers teaching science in a departmentalized classroom demonstrate a more positive attitude toward science than teachers teaching science in a self-contained classroom. They investigated the difference in attitudes toward science between science teachers in a departmentalized classroom and a self-contained classroom. No significant difference in attitudes toward science was found between science teachers in these two types of classroom organization.

Another study involved classroom organization and the assessment of attitudes toward science and science teaching (Earl and Winkeljohn, 1977).

The results supported the conclusion of Shrigley and Johnson (1974). Earl and Winkeljohn reported no significant difference in attitudes toward science between self-contained format teachers and departmentalized format teachers. Contradictorily, in the assessment of attitude toward science teaching, they found the teachers in the departmentalized format scored significantly higher than teachers in the self-contained format.

Sex Differences in Science Achievement

Sex represents a basic difference between people. Most of the evidence seems to indicate that the largest and most pervasive differences between sexes are in their interests, values, and general orientation to life (Anderson, 1972). Anderson observed that in the United States, men on the average, tend to be more interested in scientific, mechanical, political, computational, and physically strenuous or adventuresome activities, while women tend to prefer literary, musical, artistic, social service, and sedentary activities.

In discussing the ability differences between sexes, Messick (1972) cited research evidence showing that males have been generally found to excel in speed and coordination of gross bodily movements, mechanical comprehension, spatial orientation, analytical ability and quantitative reasoning, whereas females tend to excel in perceptual speed and accuracy, manual dexterity, memory, verbal fluency, and such mechanics of language as grammar and spelling.

The evidence of sex differences from the study by Pitcher (1974) suggested that women were more indirect, illogical, circuitous in their thinking than are men. Men's thinking was considered to be more

analytical, definite, precise, abstract, and direct.

Anastasi (1958), Maccoby (1966), and Tyler (1956 and 1969) agreed that girls do better in verbal and linguistic studies than boys, and boys generally show stronger numerical and spatial aptitudes and perform better on tests of mathematical reasoning.

With this general statement about sex differences as an introduction, the investigator will proceed to review the literature that focusses on sex differences in science achievement. Many studies from Western Europe and the United States have shown that there are differences between boys and girls in the level of achievement in science (Shaycoft et al., 1963; Comber and Keeves, 1973; Finn, 1980; Waetjen, 1965; Guilford, 1967; and Tyler, 1956).

Waetjen (1965) investigated the difference in academic skills between male and female students. The results obviously showed that girls had marked superiority over boys in the language area. Waetjen commented that since school is essentially a verbal, symbolic, and linguistic experience, it is small wonder that girls do better than boys. It is the opposite in mathematics and science areas where boys are more superior than girls. He suggested that this superiority could be attributed to the fact that analytical thinking is the cognitive skill which undergird mathematics and science. The skill in analytical thinking is associated with the greater aggressiveness of males.

In discussing sex differences in educational outcomes, Finn (1980) stated that boys traditionally excel in science topics such as physics and chemistry introduced in western schools at a relatively late grade, while girls do not generally achieve as highly. Finn proceeded to show that girls have poorer attitudes toward science as a school subject, and

do not take it as often when given a choice. Ultimately, women do not become scientists as often as men, even in Sweden, a county with egalitarian goals (Finn, 1980).

Sex differences were remarkably similar across the three countries involved in Finn's study (United States, Sweden, and England). Boys exceeded girls in science achievement, often by large amounts except in biology. Boys had more positive attitudes toward science, participated more in science activities, and thought of science as an easier and more orderly subject to learn. Even though girls had poorer attitudes toward science, they viewed science as being at least as important as males did, and probably more so. Finn commented:

> Whether girls may find themselves unable to excel at a skill significant to the maintenance of society or whether they believe it to be significant simply because they find it complex, with males valuing and striving to succeed at these skills is not clear (p. 21).

Finn's finding is supported by Comber and Keeves (1973) when they reported in their international science study that boys performed better than girls in science. The difference between the sexes was much more pronounced in the physical sciences than in the biological sciences. A strong preference by girls for the biological sciences was noticed in almost every country included in their study.

It is relevant that not only did boys excel in cognitive aspects, but they showed consistently more favorable attitudes toward science than girls, as evidenced by their responses to the Science Interests and Activities Scale (Comber and Keeves, 1973).

Sex differences in attitudes toward science were consistent with enrollment patterns in the various science subjects. At the university level, the enrollments of males outnumbering females in science courses were evidence in every country in IEA (International Association for the

Evaluation of Educational Achievement) survey (Comber and Keeves, 1972). Similar patterns were found in secondary schools. For example, in England the girls constituted about a fifth of the enrollments in physics, and about a quarter of enrollments in chemistry although in biology there was a balance in enrollment (HMSO, 1972).

Several authors have sought to explain sex differences in enrollments in terms of social forces (Tyler, 1956; Hutchings and Clowsley, 1970; Wells, 1967). Baumrind (1972) pointed out that socialization practices reinforce the conception that males should be independent, achievement-oriented and dominant; females are expected to be socially responsible, friendly, and cooperative. These personality variables and sex roles appear to be linked to the subject choices of boys and girls (Hutchings, 1967).

For genetic reasons, males are more superior in spatial ability (Guilford, 1967; Tyler, 1956; Hutt, 1972), mathematical ability (Ernest, 1976; Maccoby and Jacklin, 1974), curiosity and problem-solving ability (Greenburger et al., 1971). Gardner (1975) pointed out that possibly these innate cognitive differences between males and females influence attitude and enrollment patterns.

Broverman et al. (1968) stated that the sex differences in abilities are linked to physiological and biological differences between the sexes. However, Hein (1970) pointed out that critical tests of the hypothesis that innate factors influence in sex differences cannot be made until women have achieved equal vocational, social, and educational opportunities.

The controversy over the origin of sex differences whether innate or learned has raged for centuries, and the last word is still to be

said. Pitcher (1974) studied the origin of sex differences with preschool children. Through her study it was suggested that psychological sex differences existed from a very early age. By two through four years of age, boys and girls had strikingly different interests and attitudes. Pitcher proposed that this is because their parents unconsciously and steadily influence and strengthen them.

Tyler (1969) measured ability and achievement of students at primary and lower secondary school levels. It was found that the variation between the sexes was small when compared with the variation within groups of the same sex. Sex differences in science achievement were found to steadily increase as students grow older (Comber and Keevers, 1973).

In discussing the origins of sex differences in science achievement, Comber and Keeves (1973) commented:

> Whether the causes of this sex difference are innate, which seems unlikely, or whether they are the result of traditional practice in child rearing and formal education, it is impossible to say at this juncture (p. 148).

Comber and Keeves pointed out that the origin of sex differences in science achievement deserves further attention if justice is to be done to girls in the field of science education and if a country is to make the most of its human resources in scientific and technological development.

Sells (1973, 1975) stated that differences in mathematical training affected the participation by women in many other scientific and technological fields requiring some degree of mathematical sophistification. She commented that mathematics is a critical filter that tends to eliminate women from many fields, such as chemistry, physics, engineering, architecture, and medicine.

Types of education provided for males and females were found to reflect in their levels of achievement in science. In coeducational schools where boys and girls were taught together, sex differences in science achievement of students in the fourth grade were found to be less than in single-sex schools. Similarly, the performances of eighth-grade boys in single-sex schools exceeded the performances of girls by a greater amount than in coeducational schools (Comber and Keeves, 1973).

The finding of Comber and Keeves is supported by Finn (1980) when he reported that some of the largest differences in performance between the two sexes in coeducational schools, e.g., ninth-grade physics, practical science, and science attitudes were significantly smaller than in single-sex institutions. Finn gave one example: ninth-grade girls in all-girls schools were generally superior in biology and chemistry than boys. Finn proposed three factors that might contribute to much better science performance by girls in all-girls schools: (1) the assignment of female science instructors, (2) the success of classmates of the same sex in science, and (3) no competition with the opposing sex (Finn, 1980).

Teacher Education Programs in Thailand

In studying teacher education programs of Thailand, one should understand the Thai educational system and structure. The educational system of Thailand has undergone several changes. In 1978, the elementary and secondary education changed from 7-3-2 system (Pratom I-VII, Matayom Suksa I-III , and Matayom Suksa IV-V) to 6-3-3 (Pratom I-VI, Matayom I-III, and Matayom IV-VI) as shown in Table I. The school changed from a three-term year to a two-semester year, and the external examination was

replaced by a modernating system (White and Butts, 1975).

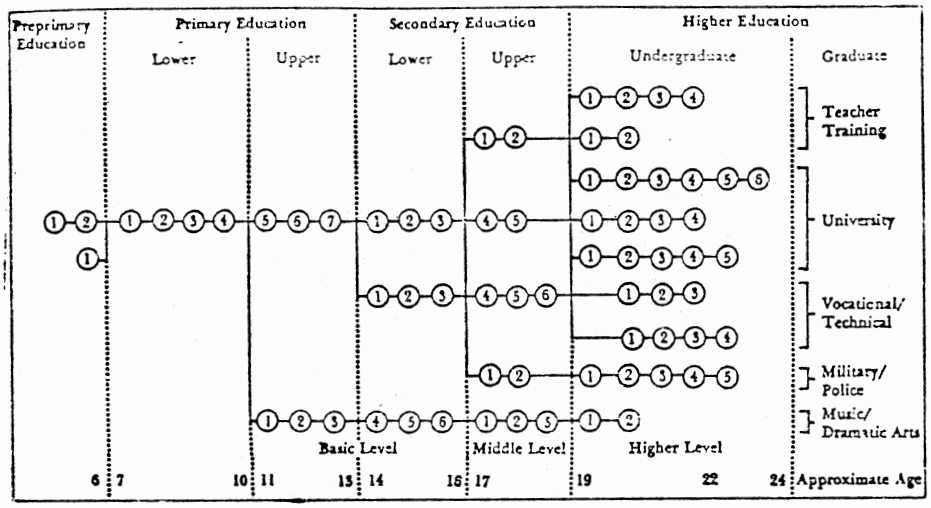
TABLE I

EQUIVALENCY TABLE FOR CURRENT (1960-PRESENT) AND PROPOSED (1978) PRIMARY-SECONDARY SYSTEMS

Age	Year in School	1960-Present		Proposed 1978	
18	12	M.S. V	Upper Secondary	Matayom VI	Upper Secondary
17	11	M.S. IV		Matayom V Matayom IV	
16	10	M.S. III	Lower Secondary	Matayom III	Lower Secondary
15	9	M.S. II		Matayom II	
14	8	M.S. I		Matayom I	
13	7	Pratom VII	Upper Elementary (compulsory)	Pratom VI	Elementary (compulsory)
12	6	Pratom VI		Pratom V	
11	5	Pratom V		Pratom IV Pratom III	
10	4	Pratom IV	Lower Elementary (compulsory)	Pratom II	
9	3	Pratom III		Pratom I	
8	2	Pratom II			
7	1	Pratom I			

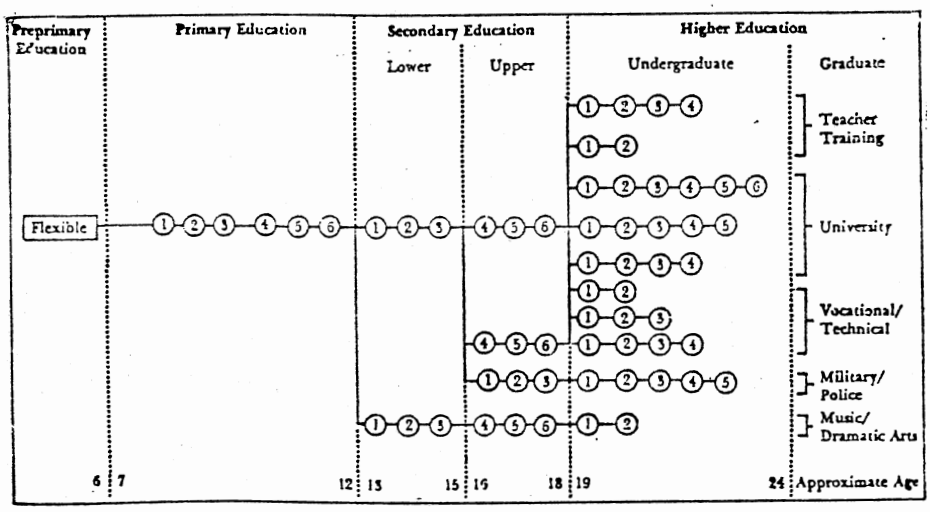
Source: J. K. Johnson, Thailand, a Study of Educational System of Thailand and a Guide to the Academic Placement of Students from Thailand in Educational Institutions of the United States. Washington, D. C.: American Association of Collegiate Registrars and Admissions Officers, 1978.

Currently, both 1960-1977 Thai National Scheme of Education (Figure 1) and the 1978 Proposed Thai National Scheme of Education (Figure 2) are being used. A proposed system is being implemented one year at a time on both the elementary and secondary levels. This was begun in 1978, and will be run concurrently with the 1960-1977 system until 1983;



Source: J. K. Johnson, Thailand: A Study of Educational System of Thailand and a Guide to the Academic Placement of Students From Thailand in Educational Institutions of the United States. Washington, D.C.: American Association of Collegiate Registrars and Admissions Officers, 1978.

Figure 1. Thai National Scheme of Education (1960-77)



Source: J. K. Johnson, Thailand: A Study of Educational System of Thailand and a Guide to the Academic Placement of Students From Thailand in Educational Institutions of the United States. Washington, D.C.: American Association of Collegiate Registrars and Admissions Officers, 1978.

Figure 2. Proposed Thai National Scheme of Education (1978)

i.e., Pratom I and Matayom I (grades 1 and 7) were implemented in 1978, Pratom II and Matayom II (grades 2 and 8) were implemented in 1979, etc., until the proposed system is fully implemented (Johnson, 1978).

The following pattern of education set forth in the Proposed Thai National Scheme of Education in 1978:

1. Preprimary education organized in elementary schools or kindergarten schools. The length of time is flexible.

2. Primary education (Pratom I-VI, grades 1-6), or elementary education, is compulsory. All children above seven years of age unless exempted for valid reasons, are required to attend school until they have completed Praton VI. Education is free in the public schools.

3. Secondary education (Matayom I-VI, grades 7-12) is organized in two streams: the general stream which aims chiefly at general education; and the vocational stream, which aims chiefly to give specific vocational and educational preparation and training. In the general stream, there are three lower secondary grades (grades 7-9) and three upper secondary grades (grades 10-12) that are pre-university grades. The vocational stream is organized to teach various vocational subjects at both lower and upper secondary levels.

4. Higher education includes teacher education, vocational/technical education, and university (Asian Institute for Teacher Educators, 1972, and Johnson, 1978).

Originally, education in Thailand took place in the temple and was taught by the monks. Only men needed to be educated because at some time they would serve as Buddhist monks (Darling, 1971). The first teacher training school was established in 1892, when the Department of Education was enlarged to become the Ministry of Education. Since then, several

teacher training schools have been developed and a variety of training programs offered for elementary teacher training (Asian Institute for Teacher Educators, 1972).

In 1949, the Prasarnmitr Training School was established and four years later became the College of Education. The college first offered a four-year course leading to a bachelor's degree in Education. The Prasarnmitr Training School now is called Sri Nakharinwirot University, which has eight campuses of its own, all with Faculties of Education (Asian Institute for Teacher Educators, 1972).

In 1916, Chulalongkorn University organized a course for a diploma in Education which was later enlarged to a degree program at its Faculty of Education (Asian Institute for Teacher Educators, 1972).

The current teacher preparation in Thailand is carried out in the Faculty of Education of eight universities and in teacher training colleges. Since the preservice teachers involved in this study are in teacher training colleges, this literature review has focused on teacher preparation within teacher training colleges.

Most of the teachers are trained in 36 teacher training colleges (Table II) located in key locations throughout the country. These colleges are under the Teacher Training Department of the Ministry of Education. The colleges have been established according to both population distribution and geography, with the objective of upgrading the quality of teacher education and training teachers in surroundings that contain living, social, and cultural conditions similar to those they will encounter in professional assignments. The Thai government believes that by training local people locally they will be able to help solve the problem that teachers have had relating to local people and participating

TABLE II

THIRTY-SIX TEACHER TRAINING COLLEGES - BACHELOR OF EDUCATION MAJORS OFFERED AT SEVENTEEN COLLEGES

Teacher Training Colleges	Majors at Colleges Offering Bachelor of Education
Ban Somdej Chao Phaya	English, Geography, History, Social Studies, Thai
Buri Rum	-
Chachaengsao	-
Chandrakaseam	General Science, Mathematics
Chanthaburi	-
Chiang Mai	Chemistry, English, General Science Thai
Chaing Rai	-
Kampaeng Phet	-
Kanchanaburi	-
Lampang	-
Loey	-
Maha Sarakham	English, Social Studies, Thai
Mooban Chombueng, Ratchburi	-
Nakhon Pathom	-
Nakhon Ratchasima	General Science
Nakhon Sawan	General Science, Social Studies
Nakhon Sri Thammarat	General Science
Phetchaboon	-
Phetchaburi, Bangkok	-
Phetchaburi Vidyalongkorn, Phrathumthani	-
Phuket	-
Piboonsongkram Phitsanulok	Thai
Pranakorn	English, Industrial Arts Ed., Thai
Phra Nakhon Sri Ayuttaya	Physics, Thai
Sakon Nakhon	-
Songkhla	English
Suan Dusit	Home Economics, Social Studies
Suan Sunandha	English, Physics, Thai
Surat Thani	-
Surin	-
Tepsatree Lopburi	Biology, Geography
Thonburi	-
Ubon Ratchathani	Biology
Udon Thani	Social Studies
Utaradit	-
Yala	English

Source: Thailand, Ministry of Education. An Introduction to the Department of Teacher Training. Bangkok: Chongcharoen Press, 1976.

in local acativities (Johnson, 1978).

Prior to 1974, teacher training colleges offered the Certificate of Education (two-year program for teaching grades 1 - 4 and the Higher Certificate of Education (four-year program for teaching grades 5 - 10) their programs of study. In 1974, they were gratned the right to offer a degree at a baccalaureate level. The purpose was to upgrade both school education and teacher education at all levels (Chungchareon, 1978). Of 36 teacher training colleges, 17 colleges received degree-granting authority. The Bachelor of Education majors offered at those colleges are presented in Table II.

The teacher training curriculum was revised in the 1975 academic year, with the goal being to prepare teachers with sufficient knowledge, ability, and skills for their roles in society and for their own development and the development of others in the national context (Chungchareon, 1978).

Under the new teacher training curriculum, graduates of the upper secondary level (Matayom VI / grade 12), who pass the Department of Training entrance examination or the Certificate of Education holders with a 2.5 GPA, are eligible for admission to a Higher Certificate of Education (Thailand, Ministry of Education, 1976).

Prior to 1976, graduates of the lower secondary level (Matayom Suksa III/proposed Matayom IV/grade 10) were admitted to the Certificate of Education program (two-year training) for elementary school teaching. The Certificate of Education is now being phased out. All current students enrolled in this program are required to complete their study by 1981, and there will be no admission of new students to this program (Thailand, Ministry of Education, 1973).

Prior to 1976, 130 credits were required (one credit is equal to one hour per week for 12 weeks) for the Higher Certificate of Education. The required and general courses are shown in Table III. When the Certificate of Education is phased out in 1981, the Higher Certificate of Education will be required for teaching at elementary level. The Revised Higher Certificate of Education Curriculum is shown in Table IV (Johnson, 1978).

Student teaching is required for graduation, and is carried out in the final year of the program. An assessment of student teaching is made by cooperating teachers and college supervisors (Asian Institute for Teacher Educators, 1972).

Higher Certificate of Education holders may enroll as third year students in the Bachelor of Education program at one of the 17 teachers' colleges. Beginning in 1981, the Bachelor of Education degree will be required for teaching at the secondary level (Johnson, 1978).

All examinations of teacher training colleges are internal. Semester examinations and the final examinations for each course are set by a group of instructors in the institution (Asian Institute for Teacher Educators, 1972). Assessment is continuous, and the grading system is A - Excellent = 4 points, B - Good = 3 points, C - Fair = 2 points, D - Poor = 1 point, and E - Failure = 0 point. A GPA of 2.0 is required for graduation (Johnson, 1978).

Summary

The following areas of review of related literature have been presented in this chapter:

1. The fundamental concepts of the nature of attitude, its

TABLE III

HIGHER CERTIFICATE OF EDUCATION CURRICULUM - 1967-1975

General Courses, Majors, Minors, and Education Courses	Credits
General Courses (30 credits)	
Thai	10
English	10
Electives (student may choose from the following areas)	10
- Geography and History	
- General Science	
- Mathematics	
- Religion	
- Culture and Thai Customs	
Majors and Minors (80 credits)	
One major - the following areas are offered	40
- English	
- Home Economics	
- Mathematics	
- Science	
- Social Studies	
- Thai	
Two Minors (20 credits each, selected from the following areas	40
- Agriculture	
- Art	
- Decorative Art	
- Practical Arts	
Education Courses (including student teaching)	20
Total	130

Source: Thailand, Ministry of Education. An Introduction to the Department of Teacher Training. Bangkok: Chongcharoen Press, 1976).
NOTE: With the discontinuance of the former Certificate of Education, the Higher Certificate of Education (1967-1975) will be known as the Certificate of Education.

TABLE IV

REVISED HIGHER CERTIFICATE OF EDUCATION CURRICULUM, 1976

General Courses, Major, Minors and Education Courses	Credits
General Courses (24 semester hours)	
Thai or English	2
Library Science	1
Philosophy	2
Music or Art Appreciation	1
Government	2
History or Geography or Social Studies	2
Mathematics	2
Science	2
Physical Science	2
Agriculture or Industrial Arts	1
Physical Education	3
Thai	4
Majors (14 semester hours, the following areas are offered)	14
Agriculture	
Arts	
English	
Geography	
History	
Mathematics	
Science	
Social Studies	
Thai	
Minors (8 semester hours, only two areas are offered: Home Economics and Industrial Arts)	8
Education Courses (including student teaching)	24
Total	70

Source: Thailand, Ministry of Education. An Introduction to the Department of Teacher Training. Bangkok: Chongcharoen Press, 1976.

importance, and the process in which it is acquired.

2. The variety of views on attitude in science education including the two broad categories, attitude toward science and scientific attitude.

3. Several factors influence the attitudes of both inservice and preservice teachers toward science. These factors involve preservice and inservice teachers' personal characteristics, educational experiences, and professional experiences.

4. Sex differences in science achievement and attitude toward science.

5. The review of the educational system and the teacher education program in Thailand has been presented to improve understanding of the characteristics of the population under study.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

This chapter includes a discussion of the techniques and procedures that were followed in conducting this study. The discussion is divided into the following major sections: (1) population and subjects, (2) instrumentation, (3) procedure, and (4) statistical treatment.

Population and Subjects

The population for this study was preservice science teachers in a senior year of a two-year program for elementary and lower secondary teacher training (grades 1-9) in 36 teacher training colleges in Thailand. No attempt was made to secure a random sample, since the investigator lacked representatives in several colleges. The available subjects consisted of 376 preservice teachers, all enrolled in student teaching at eight teacher training colleges during the Fall semester of 1980-1981. Two colleges were chosen from each geographic region by using the following criteria:

1. The colleges are located almost at the center of each geographic region
2. Communications have been previously established and a positive working relation exists between the college faculty and the researcher.

Instrumentation

The instrument used in this study was the Science Teaching Attitude Scales (Appendix E), which was developed by Moore (1973). This instrument assesses attitudes in two areas: attitude toward science and attitude toward science teaching.

The instrument contains 70 items that assess both positive and negative attitudes in these two areas. These items are called attitude statements. Attitude statements are grouped into 14 scales (Appendix F), with five attitude statements for each scale. These are called position statements. Of the 14 scales, four scales assess negative attitudes toward science, four scales assess positive attitudes toward science, three scales assess positive attitudes toward science teaching, and three scales assess negative attitudes toward science teaching.

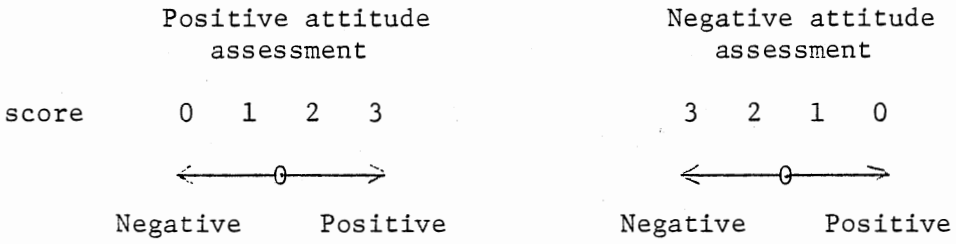
The subjects were asked to respond to each of the 70 attitude statements with the following options:

	Positive Statement	Negative Statement
1. agree strongly	3	0
2. agree mildly	2	1
3. disagree mildly	1	2
4. disagree strongly	0	3

In scoring positive statements, the alternatives are weighted 3, 2, 1, and 0 points. In scoring negative statements, these weights are reversed. Each statement carries a maximum score of 3 points and a minimum score of 0. The sum of the scores of five attitude statements for each scale is determined. Thus the maximum score for each scale is 15, and the minimum score is zero. This provides a score range of 0-60 for positive and negative attitudes toward science, and a

range of 0-120 for general attitude toward science. The range of score for positive and negative attitude toward science teaching is 0-45 with a range of 0-90 for general attitude toward science teaching.

The positive-negative attitude index for this study is established by the following criterion:



1. In scoring positive statements, scores of 0 and 1 points are for negative attitude, and scores of 2 and 3 points are for positive attitude.

2. In scoring negative statements, scores of 0 and 1 are for positive attitude, and scores of 2 and 3 points are for negative attitude (Sax, 1974).

If the mean score of any preservice teacher is 60 or above in the assessment of attitude toward science, and 45 or above in the assessment of attitude toward science teaching, it is said that the preservice teacher tends to possess positive attitudes toward science and science teaching. If the mean score of any preservice teacher is below 60 in the assessment of attitude toward science, and below 45 in the assessment of attitude toward science teaching, it is said that the preservice teacher tends to possess negative attitudes toward science and science teaching.

By using the test-retest method, Moore (1973) established the reliability of the total score on the six scales relating to science teaching.

The reliability coefficient obtained was 0.816. The same technique was used to establish the reliability of the total score on the eight scales relating to science attitudes. The reliability coefficient obtained was 0.934 (Moore and Sutman, 1970). Based on the comparison of pre-pretest and pretest totlal scores on the Science Teaching Attitude Scales and the comparison of pretest and pretest total scores during the field testing phase of the scales, Moore concluded that there is evidence for construct validity for the scales used as a group (Moore, 1973). In a separate study, Moore showed that the scales relating to a collective attitude toward science have construct validity (Moore and Sutman, 1970).

Procedure

The Science Teaching Attitude Scales (Appendix E) used in this study were previously translated into the Thai language. This translation was edited by the investigator, then evaluated by five Thai students at Oklahoma State University. Suggested revisions were made before mailing it to the investigator's representative in Bangkok, Thailand. The test was then duplicated and distributed to faculty members of teacher training colleges involved in the study. The 376 subjects responded to the attitude statements following their student teaching experiences. The test was accompanied by a cover letter (Appendix C) and a participant information sheet (Appendix D).

Statistical Treatment

Since the teacher training colleges were not randomly selected, a nonparametric statistical technique was used in this study. In testing

the hypothesis H_{01-a} and H_{01-b}, the basic chi square test of deviation from the expected frequencies was employed. The chi square test of association was utilized to test hypotheses H_{03-a}, H_{03-b}, H_{04-a}, H_{04-b}, H_{05-a}, H_{05-b}, H_{06-a}, H_{06-b}, H_{07-a}, H_{07-b}, H_{08-a}, and H_{08-b} (Siegel, 1956). The contingency coefficient was computed to determine the degree of relationship between attitudes toward science and science teaching and each of the six variables (Bruning and Kintz, 1977). A Spearman rank correlation coefficient (r_s) was employed to test hypotheses H_{02}, H_{03-c}, and H_{03-d}. A critical-ratio z-test was used to test the sifnificance of r_s (Bruning and Kintz, 1977). Hypotheses were rejected at the .05 level of significance for all tests.

Data for this study were obtained from individual subjects and treated individually. Some individuals did not respond to all attitude statements. Those with more than two non-response items in each assessment (attitudes toward science and science teaching) were not analyzed as part of the study. Usable response data were punched on cards and analyzed with a computer program using the Statistical Analysis System (SAS).

Summary

The discussion in Chapter III focused on population and subjects involved in the study, information about the instrumentation, the method and procedure of collecting data, and the statistical technique employed in the analysis of data. The data were collected during the Fall of 1980-1981.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

As indicated in Chapter I, the purpose of this study is to investigate current attitudes of Thai preservice elementary science teachers toward science and science teaching, and the relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching and six control variables. A total of 376 subjects from eight teacher training colleges located in Thailand were involved in this study. The instrument and the scoring key appear in Appendixes E and F, respectively.

This chapter includes the analysis of the data. Seventeen null hypotheses were tested and the results were reported in tabular form. The .05 significance level was used in rejecting all null hypotheses. Data obtained from the subjects are presented in Appendix I. The ranges, means, and standard deviations of attitude responses are shown in Table V. The data were organized into quartiles. Only those attitude responses which were above the first quartile and below the third quartile were considered in testing the H_{03-a}, H_{03-b}, H_{04-a}, H_{04-b}, H_{05-a}, H_{05-b}, H_{06-a}, H_{06-b}, H_{07-a}, H_{07-b}, H_{08-a}, and H_{08-b}.

TABLE V

N, TOTAL SCORE, MINIMUM RESPONSE, MAXIMUM RESPONSE, MEANS, AND S. D. OF ATTITUDE RESPONSE TOWARD SCIENCE AND SCIENCE TEACHING

Variable	N	Total Score	Minimum Response	Maximum Response	Means	S.D.
Attitude toward science	376	120	45	95	70.55	6.06
Attitude toward science teaching	376	90	36	71	53.82	5.99

Testing the Hypotheses

The following null hypotheses were tested:

Hypothesis H_{01-a}

There is no significant difference in the proportion of Thai pre-service elementary science teachers responding to a positive or negative attitude toward science.

The basic chi-square value for testing whether a significant difference existed between the observed number of responses falling in each category and the expected number based on H_{01-a} is shown in Table VI.

The obtained chi-square was greater than the tabled chi-square; therefore, the deviation of the observed frequencies from the expected frequencies was significant at the .05 level led to the rejection of H_{01-a}. Inspection of the data indicated that frequencies of subjects responding with a positive attitude toward science were higher than those responding with a negative attitude.

TABLE VI

X^2 TESTING DEVIATION FROM THE EXPECTED VALUES OF THE OBSERVED VALUES FALLING IN EACH OF THE POSITIVE AND NEGATIVE ATTITUDE LEVELS

Variable	Level of Attitude		N	X^2	df	P
	Positive	Negative				
Attitude toward science	366(188)	10(188)	376	335.17	1	0.0001
Attitude toward science teaching	351(188)	25(188)	376	280.92	1	0.0001

Numbers enclosed in parentheses are expected values.
The X^2 values were significant at the .05 level.

Hypothesis H_{01-b}

There is no significant difference in the proportion of Thai pre-service elementary science teachers responding with a positive or negative attitude toward science teaching.

The basic chi-square value for testing whether a significant difference existed between the observed number of responses falling in each category and the expected number based on H_{01-b} is shown in Table VI.

The obtained chi-square was greater than the tabled chi-square; therefore, the deviation of the observed frequencies from the expected frequencies was significant at the .05 level and led to the rejection of H_{01-b}. Inspection of the data indicated that frequencies of subjects responding with a positive attitude toward science teaching were greater than those responding with a negative attitude.

Hypothesis H_{02}

There is no significant relationship between the sets of rank-ordered scores in attitudes of Thai preservice elementary science teachers toward science and science teaching.

Computing a Spearman rank correlation coefficient, a value of r_s = .03 was obtained. The critical-ratio z-test was employed in testing the significance of r_s because the number of subjects was larger than 30. With N = 376, a value of z = 6.66 was obtained. Using a two-tailed test, the z computed was greater than the z tabled (1.96), then r_s was significant at the .05 level. H_{02} was rejected. Therefore, a significant positive correlation existed between attitudes of Thai preservice elementary science teachers toward science and science teaching.

Hypothesis H_{03-a}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between male and female Thai preservice elementary science teachers.

The chi-square value for testing a relationship between attitudes toward science and Thai preservice elementary science teachers' sex is shown in Table VII. The chi-square value was not significant at the .05 level, and the contingency coefficient was 0.11. H_{03-a} was not rejected. Therefore, no significant relationship existed between sex and attitudes of preservice elementary science teachers toward science.

Hypothesis H_{03-b}

There is no significant difference in the proportion of upper quartile

or lower quartile attitude responses toward science teaching between male and female Thai preservice elementary science teachers.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and their sex is shown in Table VII. The obtained X^2 was not significant at the .05 level, and the contingency coefficient was 0.02. H_{03-b} was not rejected. Therefore, no significant relationship existed between sex and attitudes of Thai preservice elementary science teachers toward science teaching.

TABLE VII

X^2 TESTING A RELATIONSHIP BETWEEN SEX AND ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING

Sex of Preservice Teachers	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Male	24 (28.7)	36 (31.3)	31 (30.2)	37 (37.8)
Female	62 (57.3)	58 (62.7)	52 (52.8)	67 (66.2)
	$X^2 = 2.21$, df = 1 P = 0.14 C = 0.11		$X^2 = 0.08$, df = 1 P = 0.77 C = 0.02	

Numbers enclosed in parentheses are expected values.
The X^2 values were not significant at the .05 level.

Table VIII presents percents of positive and negative attitude

responses toward science and science teaching classified by sex.

TABLE VIII

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF MALE AND FEMALE THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS

Sex of Preservice Teachers	Attitude Toward Science		Attitude Toward Science Teaching		
	% Positive	% Negative	% Positive	% Negative	N
Male	32.27	0.80	30.13	2.93	124
Female	65.06	1.87	63.47	3.47	251
Total	97.33	2.67	93.60	6.40	375

Hypothesis H_{03-c}

There was no significant relationship between the sets of rank-ordered scores in attitudes of male Thai preservice elementary science teachers toward science and science teaching.

Computing a Spearman rank correlation coefficient, a value of $r_s = 0.44$ was obtained. The critical-ratio z-test was used to test the significance of r_s beacuse the number of subjects was larger than 30. With $N = 124$, a value of $z = 4.90$ was obtained. Using a two-tailed test, the obtained z exceeded the tabled z, then r_s was significant at the .05 level. H_{03-c} was rejected. Therefore, a significant positive correlation existed between attitudes of female Thai preservice elementary science teachers toward science and science teaching.

Hypothesis H_{03-d}

There is no significant relationship between the sets of rank-ordered scores in attitudes of female Thai preservice elementary science teachers toward science and science teaching.

A spearman rank-ordered correlation coefficient was calculated. A value of $r_s = 0.29$ was obtained. The critical-ratio z-test was employed to test the significance of r_s because the number of subjects was larger than 30. With N = 251, a value of z = 4.60 was obtained. Using a two-tailed test, the z value was greater than the tabled z, then r_s was significant at the .05 level. H_{03-d} was rejected. Therefore, a significant positive correlation existed between attitudes of male Thai preservice elementary science teachers toward science and science teaching.

Hypothesis H_{04-a}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers graduating from private and public secondary schools.

The chi-square value for testing a relationship between attitude of Thai preservice elementary science teachers toward science and type of secondary school is shown in Table IX. The chi-square value was significent at the .05 level, and the contingency coefficient was 0.02. H_{04-a} was rejected. Therefore, a significant relationship existed between the attitudes of Thai preservice elementary science teachers toward science and the private/public type of secondary school.

TABLE IX

X^2 TESTING A RELATIONSHIP BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING AND TYPE OF SECONDARY SCHOOL

Type of Secondary School	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Public	66 (72.4)	84 (77.6)	72 (73.5)	91 (89.5)
Private	19 (12.6)	7 (13.4)	11 (9.5)	10 (11.5)
	$X^2 = 7.52^*$, df = 1 P = 0.01 C = 0.20		$X^2 = 0.54$, df = 1 P = 0.46 C = 0.05	

*Significant value.
Numbers enclosed in parentheses are expected values.

Hypothesis H_{04-b}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers graduating from private and public secondary schools.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and type of secondary school is shown in Table IX. The obtained chi-square was not significant at the .05 level and the contingency coefficient was 0.05. H_{04-b} was not rejected. Therefore, no relationship existed between attitudes of Thai preservice elementary science teachers toward science teaching and the private/public type of secondary school.

Shown in Table X are percents of positive and negative attitude responses toward science and science reaching of Thai preservice elementary science teachers attending private/public secondary schools.

TABLE X

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS GRADUATING FROM PUBLIC AND PRIVATE SCHOOL

Type of Secondary School	Attitude Toward Science		Attitude Toward Science Teaching		N
	% Positive	% Negative	% Positive	% Negative	
Public	84.59	2.44	81.62	5.41	322
Private	12.97	0.00	11.89	1.08	48
Total	97.56	2.44	93.51	6.49	370

Hypothesis H_{05-a}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers from the four geographic cultural patterns.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns is shown in Table XI. The obtained chi-square was significant at the .05 level. Contingency coefficient

was 0.21. H_{05-a} was rejected. Therefore, a relationship existed between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns.

TABLE XI

X^2 TESTING A RELATIONSHIP BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING AND THE FOUR GEOGRAPHIC CULTURAL PATTERNS

Geographic Cultural Patterns	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Central	23 (20.5)	20 (22.5)	27 (23.7)	26 (29.3)
North	27 (29.6)	35 (32.4)	29 (32.6)	44 (40.4)
South	26 (20.1)	16 (21.9)	16 (15.2)	18 (18.8)
Northeast	10 (15.8)	23 (17.2)	12 (12.5)	16 (15.5)
	$X^2 = 8.41^*$ df = 1 P = 0.04 C = 0.21		$X^2 = 1.68$ df = 1 P = 0.64 C = 0.09	

*Significant value.
Numbers in parentheses are expected values.

Hypothesis H_{05-b}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers from the four geographic cultural patterns.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the four geographic cultural patterns shown in Table XI. The obtained chi-square was not significant at the .05 level and the contingency coefficient was 0.09. H_{o5-b} was not rejected. Therefore, no significant relationship existed between geographic cultural pattern and Thai preservice elementary science teachers' attitudes toward science teaching.

Table XII presents percents of positive and negative attitude responses toward science and science teaching of 376 Thai preservice elementary science teachers from the four geographic cultural patterns.

TABLE XII

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS FROM THE FOUR GEOGRAPHIC CULTURAL PATTERNS

Geographic Cultural Patterns	Attitude Toward Science		Attitude Toward Science Teaching		N
	% Positive	% Negative	% Positive	% Negative	
Central	26.60	0.53	25.80	1.33	102
North	37.50	0.27	35.11	2.66	142
South	19.41	1.33	19.15	1.60	78
Northeast	13.83	0.53	13.30	1.06	54
Total	97.34	2.66	93.35	6.65	376

Hypothesis H_{06-a}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science between Thai preservice elementary science teachers student teaching in urban and ural schools.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science and location of student teaching is shown in Table XIII. The obtained chi-square was not significant at the .05 level and the contingency coefficient was 0.12. H_{06-a} was not rejected. Therefore, no significant relationship existed between attitudes of Thai preservice elementary science teachers toward science and the urban/rural location of student teaching.

TABLE XIII

X^2 TESTING A RELATIONSHIP BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING AND LOCATION OF STUDENT TEACHING

Location of Student Teaching	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Urban	37 (31.6)	30 (35.4)	35 (30.4)	33 (37.6)
Rural	47 (52.4)	64 (58.4)	49 (53.6)	71 (66.4)
	X^2 = 2.80, df = 1 P = 0.09 C = 0.12		X^2 = 2.00, df = 1 P = 0.16 C = 0.10	

Numbers enclosed in parentheses are expected values.
The X^2 values were not significant at the .05 level.

Hypothesis H_{06-b}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward science teaching between Thai preservice elementary science teachers student teaching in urban and rural schools.

The chi-square value for testing a relationship between location of student teaching and Thai preservice elementary science teachers' attitudes toward science teaching is shown in Table XIII. The obtained chi-square was not significant at the .05 level, and the contingency coefficient was 0.10. H_{06-b} was not rejected. Therefore, no relationship existed between attitudes of Thai preservice elementary science teachers toward science teaching and the urban-rural location of student teaching.

Table XIV presents percents of positive and negative attitude responses toward science and science teaching of Thai preservice elementary science teachers who student teach in urban/rural schools.

TABLE XIV

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS STUDENT TEACHING IN URBAN AND RURAL SCHOOLS

Location of Student Teaching	Attitude Toward Science		Attitude Toward Science Teaching		N
	% Positive	% Negative	% Positive	% Negative	
Urban	35.92	1.07	34.32	2.68	138
Rural	61.40	1.61	58.98	4.02	235
Total	97.32	2.68	93.30	6.70	373

Hypothesis H_{07-a}

There is no significant difference in the proportion of upper quartile or lower quartile attitude responses toward scicnce between Thai preservice elementary science teachers having majority male and female college science teachers.

The chi-square value for testing a relationship between number of majority male/female college science teachers and Thai preservice elementary science teachers' attitudes toward science is shown in Table XV. The obtained chi-square was not significant at the .05 level, and the contingency coefficient was 0.02. H_{07-a} was not rejected. Therefore no relationship existed between attitude of Thai preservice elementary science teachers toward science and the number of majority male/female college science teachers.

TABLE XV

X^2 TESTING A RELATIONSHIP BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING AND THE NUMBER OF MAJORITY MALE/FEMALE COLLEGE SCIENCE TEACHERS

Numbers of College Science Teachers	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Majority Male	45 (44.4)	50 (50.6)	40 (37.8)	50 (52.2)
Majority Female	20 (20.6)	24 (23.4)	18 (20.2)	30 (27.8)
	X^2 = 0.08, df = 1 P = 0.78 C = 0.02		X^2 = 0.67, df = 1 P = 0.41 C = 0.07	

Numbers enclosed in parentheses are expected values.
The X^2 values were not significant at the .05 level.

Hypothesis H_{07-b}

There is no significant difference in the proportion of upper quartile or lower quartile responses toward science teaching between Thai preservice elementary science teachers having majority male and female college science teachers.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers is shown in Table XV. The obtained chi-square was not significant at the .05 level and the contingency coefficient was 0.07. Therefore, no relationship existed between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers.

Table XVI presents percents of positive and negative attitude responses toward science and science teaching of Thai preservice elementary science teachers having majority male/female college science teachers.

TABLE XVI

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS HAVING MAJORITY MALE AND FEMALE COLLEGE SCIENCE TEACHERS

Number of College Science Teachers	Attitude Toward Science		Attitude Toward Science Teaching		
	% Positive	% Negative	% Positive	% Negative	N
Majority Male	63.83	2.48	62.06	4.26	187
Majority Female	33.69	0.00	31.56	2.13	95
Total	97.52	2.48	93.62	6.38	282

Hypothesis H_{08-a}

There is no significant difference in the proportion of upper quartile or lower quartile responses toward science between Thai preservice elementary science teachers under supervision of male and female cooperating teachers.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science and the cooperating teachers' sex is shown in Table XVII. The obtained chi-square was not significant at the .05 level, and the contingency coefficient was 0.02. H_{08-a} was not rejected. Therefore, no relationship existed between attitudes of Thai preservice elementary science teachers toward science and cooperating teachers' sex.

TABLE XVII

X^2 TESTING A RELATIONSHIP BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE/SCIENCE TEACHING AND THE COOPERATING TEACHER'S SEX

Cooperating Teachers' Sex	Attitude Toward Science		Attitude Toward Science Teaching	
	Upper Quartile	Lower Quartile	Upper Quartile	Lower Quartile
Male	23 (22.3)	24 (24.7)	22 (21.4)	26 (26.6)
Female	61 (61.1)	69 (68.3)	61 (61.6	77 (76.4)
	X^2 = 0.08, P = 0.77 C = 0.02	df = 1	X^2 = 0.06, P = 0.80 C = 0.01	df = 1

Numbers enclosed in parentheses are expected values.
The X^2 values were not significant at the .05 level.

Hypothesis H_{08-b}

There is no significant difference in the proportion of upper quartile or lower quartile responses toward science teaching between Thai preservice elementary science teachers under supervision of male and female cooperating teachers.

The chi-square value for testing a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and cooperating teacher's sex is shown in Table XVII. The obtained chi-square was not significant at the .05 level and the contingency coefficient was 0.01. H_{08-b} was not rejected. Therefore, no relationship existed between attitudes of Thai preservice elementary science teachers toward science teaching and cooperating teacher's sex.

Shown in Table XVIII are percents of positive and negative attitude responses toward science and science teaching of Thai preservice elementary science teachers under supervision of male/female cooperating teachers.

TABLE XVIII

POSITIVE-NEGATIVE PERCENT ATTITUDE RESPONSES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS UNDER SUPERVISION OF MALE AND AND FEMALE COOPERATING TEACHERS

Cooperating Teachers' Sex	Attitude Toward Science		Attitude Toward Science Teaching		N
	% Positive	% Negative	% Positive	% Negative	
Male	23.99	0.81	22.91	1.89	92
Female	73.31	1.89	70.62	4.58	279
Total	97.30	2.70	93.53	6.47	371

Summary

This chapter has presented the results obtained from this study. Seventeen null hypotheses were tested. A basic chi-square test of the deviation from the expected frequencies, a two-way chi-square test of association, a contingency coefficient, and a Spearman rank ordered correlation coefficient were utilized for analysis of data.

Of the seventeen null hypotheses, seven were rejected at the .05 level of significance. These null hypotheses are: (1) H_{01-a}, (2) H_{01-b}, (3) H_{02}, (4) H_{03-c}, (5) H_{03-d}, (6) H_{04-a}, and (7) H_{05-a}.

Data analysis resulted in failure to reject ten hypotheses: (1) H_{03-a}, (2) H_{03-b}, (3) H_{04-b}, (4) H_{05-b}, (5) H_{06-a}, (6) H_{06-b}, (7) H_{07-a}, (8) H_{07-b}, (9) H_{08-a}, (10) H_{08-b}.

The results are summarized and presented in Tables XIX and XX.

TABLE XIX

SPEARMAN RANK CORRELATIONS BETWEEN ATTITUDES OF THAI PRESERVICE ELEMENTARY SCIENCE TEACHERS TOWARD SCIENCE AND SCIENCE TEACHING

Hypotheses	r_s	N	P
H_{02}	0.03	376	0.0001*
H_{03-c}	0.44	124 (males)	0.0001*
H_{04-d}	0.29	251 (females)	0.0001*

*Significant at .05 level.

TABLE XX

SUMMARY OF ANALYSIS OF X^2 TESTING FOURTEEN HYPOTHESES

Hypotheses	Components and Variables	X^2	N	df	P	C
H_{01-a}	Preservice teachers' positive and negative attitude responses toward science	335.17	376	1	0.0001*	-
H_{01-b}	Preservice teachers' positive and negative attitude responses toward science teaching	280.92	376	1	0.0001*	-
H_{03-a}	Preservice teachers' sex and attitudes toward science	2.21	375	1	0.14	0.11
H_{03-b}	Preservice teachers' sex and attitudes toward science teaching	0.08	375	1	0.77	0.02
H_{04-a}	Public/private type of secondary school and attitudes toward science	7.52	370	1	0.01*	0.20
H_{04-b}	Public/private type of secondary school and attitudes toward science teaching	0.54	370	1	0.46	0.05
H_{05-a}	Central, north, south, or northeast geographic cultural pattern and attitudes toward science	8.41	376	1	0.04*	0.21
H_{05-b}	Central, north, south, or northeast geographic cultural pattern and attitudes toward science teaching	1.68	376	1	0.64	0.09
H_{06-a}	Urban/rural location of student teaching and attitudes toward science	2.80	373	1	0.09	0.12
H_{06-b}	Urban/rural location of student teaching and attitudes toward science teaching	2.00	373	1	0.16	0.10
H_{07-a}	Number of majority male/female college science teachers and attitudes toward science	0.08	282	1	0.78	0.02
H_{07-b}	Number of majority male/female college science teachers and attitudes toward science teaching	0.67	282	1	0.41	0.07
H_{08-a}	Cooperating teachers' sex and attitudes toward science	0.83	371	1	0.77	0.02

TABLE XX (Continued)

Hypotheses	Components and Variables	X^2	N	df	P	C
H_{08-b}	Cooperating teachers' sex and attitudes toward science teaching	0.06	371	1	0.80	0.01

*Significant at .05 level.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

Earlier chapters presented a rationale for the study, a review of the literature, a collection and analysis of the data. This chapter includes a summary of the study, findings, conclusions drawn from the findings, implications of the study, and recommendations for further study.

Summary

This study seeks to investigate current attitudes of Thai preservice elementary science teachers toward science and science teaching, and explores a relationship between their attitudes toward science and science teaching. Furthermore, the study explores relationships between attitudes of Thai preservice elementary science teachers toward science/science teaching and six control variables. These six control variables are listed below:

1. preservice elementary science teachers' sex
2. public/private type of secondary school
3. North/South/Central/Northeast geographic cultural pattern
4. rural/urban location of student teaching
5. number of majority male/female college science teachers, and

6. cooperating teachers' sex.

The subjects for this study consisted of 376 preservice elementary science teachers, all enrolled in student teaching at eight teacher training colleges located in Thailand.

The Science Teaching Attitude Scales under the title "What is Your Attitude Toward Science and Science Teaching" (Appendix E) was the instrument used in this study. The test was translated into Thai language and administered to the subjects during the 1980-1981 Fall semester. The attitude responses were scored by using the scoring key (Appendix G). The data were analyzed with a computer program (SAS). The chi-square test of deviation from the expected frequencies, the chi-square test of association, the contingency coefficient, and the Spearman rank correlation coefficient were utilized as statistical techniques in testing the null hypotheses. All of the tests were rejected at the .05 level of significance.

Findings

Of the seventeen null hypotheses, data analysis resulted in the rejection of seven null hypotheses. The findings are summarized below:

1. The majority of Thai preservice elementary science teachers possessed positive attitudes both toward science and science teaching.

2. Significant positive correlations between attitudes toward science and science teaching existed for all subjects and for subjects grouped by sex.

3. Significant relationships existed between attitudes of Thai preservice elementary science teachers toward science and two of the six control variables. These two variables are a type of secondary

school and geographic cultural pattern.

4. No significant relationships existed between attitudes of Thai preservice elementary teachers toward science teaching and any of the six control variables.

Conclusions and Implications

It was the purpose of this study to investigate:

1. attitudes of Thai preservice elementary science teachers toward science and science teaching,

2. the existence of a relationship between attitudes of Thai preservice elementary science teachers toward science and science teaching,

3. the existence of relationships between attitudes of Thai preservice elementary science teachers toward science/science teaching and six control variables.

Based on the results of testing the seventeen null hypotheses, the corresponding questions stated earlier were answered.

Qu_{1-a}

Do Thai preservice elementary science teachers possess a positive or negative attitude toward science?

The rejection of H_{01-a} supports the contention that there was a significant difference in the proportions of Thai preservice elementary science teachers responding with positive or negative attitudes toward science. The data in Table VI revealed that only 2.66 percent of the subjects displayed a negative attitude toward science. This strong evidence led to the conclusion that Thai preservice elementary teachers possessed positive attitudes toward science.

Qu_{1-b}

Do Thai preservice elementary science teachers possess positive or negative attitudes toward science teaching?

The rejection of H_{01-b} supports the contention that there was a significant difference in the proportions of Thai preservice elementary science teachers responding with positive and negative attitudes toward science teaching. The data in Table VI revealed that only 6.65 percent of the subjects displayed negative attitudes toward science teaching. This strong evidence led to the conclusion that Thai preservive elementary science teachers possessed positive attitudes toward science teaching.

The results of testing H_{01-a} and H_{01-b} indicated that the majority of Thai preservice elementary science teachers possessed positive attitudes toward both science and science teaching. These findings are reasonable, since all subjects involved in this study were science majors. The findings imply little need to improve positive attitudes toward either science or science teaching for Thai preservice elementary science teachers.

Qu_2

Is there a relationship between Thai preservice elementary science teachers' attitudes toward science and their attitudes toward science teaching?

The coefficient of correlation ($r_s = 0.03$) for attitudes toward science and science teaching was significantly different from zero and the direction indicated a positive relationship between attitudes toward science and science teaching of Thai preservice elementary science

teachers. The magnitude of correlation coefficient was quite low, since the number of subjects was large.

Finding a significant positive correlation between attitudes toward science and science teaching for all subjects led to the conclusion that a relationship existed between attitudes of Thai preservice elementary science teachers toward science and science teaching. This finding may have implication concerning elementary science teacher training. Thai science educators should be aware of this finding, since it reflects and indirectly evaluates the effectiveness of the science education program in the Department of Teacher Training.

Qu_{3-a}

To what degree does a relationship exist between sex and attitudes of Thai preservice elementary science teachers toward science?

The failure to reject H_{03-a} does not support the contention that there was a significant relationship between sex and attitudes of Thai preservice elementary science teachers toward science. However, the contingency coefficient ($C = 0.11$) showed that the magnitude of the relationship was not perfectly zero. Lack of evidence in confirmation of a relationship between sex and attitudes of Thai preservice elementary science teachers toward science refutes the assumption that science has a masculine bias in the Thai culture. Interestingly, the data in Table VII revealed that for positive attitude responses toward science, the proportion of female Thai preservice elementary science teachers was slightly greater than the proportion of male Thai preservice elementary science teachers. For negative attitude responses toward science, the result was reversed.

Qu_{3-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and their sex?

The failure to reject H_{03-b} does not support the contention that there was a significant relationship between sex and attitudes of Thai preservice elementary science teachers toward science teaching. However, the contingency coefficient ($C = 0.02$) showed that the magnitude of the relationship was not perfectly zero. Lack of evidence in confirmation of a relationship between sex and attitude of Thai preservice elementary science teachers toward science teaching refutes the assumption that science has a masculine bias in the Thai culture. However, the data in Table VII revealed that for positive attitude responses toward science teaching, the proportion of male Thai preservice elementary science teachers was slightly greater than the proportion of female Thai preservice elementary science teachers. For negative attitude responses toward science teaching, the result was reversed.

Finding no significant relationships between sex and attitudes of Thai preservice elementary science teachers toward science and science teaching indicates that sex does not affect these attitudes. These findings imply no need for differentiated elementary science teacher training for different sexes.

Qu_{3-c}

To what degree does a relationship exist between attitudes of male Thai preservice elementary science teachers toward science and science

teaching?

The obtained Spearman rank correlation coefficient was significantly different from zero. A value of $r_s = 0.44$ was quite low, since the number of subjects was large, but it reflects a positive relationship between attitudes of male Thai preservice elementary science teachers toward science and science teaching.

Qu_{3-d}

To what degree does a relationship exist between attitudes of female Thai preservice elementary science teachers toward science and science teaching?

The obtained Spearman rank correlation coefficient was significantly different from zero. A value of $r_s = 0.29$ was quite low, since the number of subjects was large, but it reflects a positive relationship between attitudes of female Thai preservice elementary science teachers toward science and science teaching.

As indicated when testing H_{02}, H_{03-a}, and H_{03-b}, it might seem reasonable to find positive relationship between attitudes toward science and science teaching for subjects grouped by sex. However, finding significant positive correlations between attitudes of Thai preservice elementary science teachers toward science and science teachings of both sexes simply indicates that sex is an insignficant variable related to attitudes toward science and science teaching of Thai preservice elementary science teachers. These findings imply no need to take preservice elementary science teachers' sex into consideration concerning professional training.

Qu_{4-a}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the private/public type of secondary school?

The rejection of H_{04-a} supports the contention that there was a relationship between attitudes of Thai preservice elementary science teachers toward science and the private/public type of secondary school. The contingency coefficient ($C = 0.20$) indicates a moderately low, but significant relationship. Finding a significant relationship between attitudes of Thai preservice elementary science teachers toward science and the private/public type of secondary school supports the assumption that the preservice elementary science teachers graduating from public and private schools differ in attitudes toward science. Inspection of data in Table IX indicated that for positive attitude responses toward science, the proportion of preservice elementary science teachers graduating from private secondary schools was slightly higher than the proportion of those graduating from public secondary schools. For negative attitude responses toward science, the result was reversed.

Qu_{4-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the private/public type of secondary school?

The failure to reject H_{04-b} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the

private/public type of secondary school. However the contingency coefficient (C = 0.05) indicates that the magnitude of the relationship was not exactly zero. Lack of evidence in a confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the public/private type of secondary schools refutes the assumption that the preservice elementary science teachers graduating from public and private schools differ in attitudes toward science teaching.

A significant relationship between attitudes of Thai preservice elementary science teachers toward science and the public/private type of secondary school could exist with the reason that private secondary school graduates were exposed to more intensive and better science programs than the public secondary school graduates. This finding indicates a need to analyze science education programs in Thai secondary schools in order for the Department of Teacher Education to improve its effectiveness concerning science teacher training.

An explanation for finding no relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the public/private type of secondary school could be based on professional training. Both Thai preservice elementary science teachers who graduate from public and private secondary schools must be imprinted with the same philosophy and methodology of science teaching on their mind. As a result, no difference was found in the expression of attitude toward science teaching between these two groups. This finding may have implication pertaining to educating science teachers. If as suggested, attitudes of preservice science teachers toward science teaching are shaped through science teacher training, more careful training should be done by the science teacher trainer.

Qu_{5-a}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns?

The rejection of H_{05-a} supports the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns. The contingency coefficient ($C = 0.21$) indicates a moderately low, but significant relationship. The existence of a significant relationship between the attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns supports the assumption that Thai preservice elementary science teachers from four geographic cultural patterns differ in attitude toward science. The evidence supporting this assumption can be seen from the data in Table XI that for positive attitude responses toward science, the proportions of preservice elementary science teachers from four geographic cultural patterns were ranked from high to low in the following order: (1) Central, (2) South, (3) Northeast, and (4) North. For negative attitude responses toward science, the result was reversed.

Qu_{5-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the four geographic cultural patterns?

The failure to reject H_{05-b} does not support the contention that there was a significant relationship between attitudes of Thai

preservice elementary science teachers toward science teaching and the four geographic cultural patterns. The magnitude of the contingency coefficient (C = 0.09) indicates that the relationship was not exactly zero. Lack of evidence in confirmation of a relationship between the attitudes of Thai preservice elementary science teachers toward science teaching and the four geographic cultural patterns refutes the assumption that Thai preservice elementary science teachers from four geographic cultural patterns differ in attitudes toward science teaching.

An explanation for finding the significant relationship between attitudes of Thai preservice elementary science teachers toward science and the four geographic cultural patterns could be that environment as well as traditional and cultural upbringing influenced the attitudes toward science. This finding implies a need for analyzing the four geographic cultural patterns as being a significant source of these attitudinal differences.

An explanation for finding no significant relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the four geographic cultural patterns could be that Thai preservice elementary science teachers were under the same teacher training program. They experienced the same science methods course and were imprinted with the same belief system and teaching model. Therefore, the geographic cultural pattern was found not to be related to attitudes toward science teaching. This finding implies no need for differentiated science teacher training for the four geographic cultural patterns.

Qu_{6-a}

To what degree does a relationship exist between attitudes of Thai

preservice elementary science teachers toward science and the urban/rural location of student teaching?

The failure to reject H_{06-a} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science and the urban/rural location of student teaching. However, the contingency coefficient (C = 0.12) indicates that the magnitude of relationship was not exactly zero. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science and the urban/rural location of student teaching refutes the assumption that the preservice elementary science teachers student teaching in urban and rural schools differ in attitude toward science.

Qu_{6-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the urban/rural location of student teaching?

The failure to reject H_{06-b} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the urban/rural location of student teaching. Moreover, the contingency coefficient (C = 0.10) reflects a relatively low and nonsignificant relationship. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the urban/rural location of student teaching refutes the assumption that the preservice elementary teachers student teaching in urban and rural school differ in attitude toward science

teaching.

One possible explanation for finding no relationships between attitudes of the Thai preservice elementary science teachers toward science/science teaching and the urban/rural location of student teaching could be that a longer period than the duration of student teaching is needed to shape or change attitudes toward science and science teaching. These findings imply little need to provide different preparation concerning attitudes toward science and science teaching for Thai preservice elementary science teachers assigned to do their teaching in urban and rural schools.

Qu_{7-a}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the number of majority male/female college science teachers?

The failure to reject H_{07-a} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science and the number of majority male/female college science teachers. Moreover, the contingency coefficient ($C = 0.02$) reflects a relative low and nonsignificant relationship. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science and the number of majority male/female college science teachers refutes the assumption that preservice elementary science teachers having majority male and female college science teachers differ in attitude toward science.

Qu_{7-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers?

The failure to reject H_{07-b} doe not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers. Moreover, the contingency coefficient ($C = 0.07$) reflects a relative low and insignificant relationship. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the number of majority male/female college science teachers refutes the assumption that preservice elementary science teachers having majority male and female college science teachers differ in attitudes toward science teaching.

As indicated when testing H_{03-a} and H_{03-b}, there were no significant relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching and sex. Thus, it seems reasonable that the sex of college science teachers would not be related to their students' attitudes toward science and science teaching. Finding no significant relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching, and the number of majority male/female college science teachers may indicate that neither a majority of male nor of female college science teachers had a more positive effect on attitudes toward science and science teaching of their students. For administrators and curriculum

specialists, these findings point to information relevant to their tasks; that is, the sex of college science teachers should not be related to an improvement of science teacher education program.

Qu_{8-a}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science and the cooperating teachers' sex?

The failure to reject H_{08-a} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science and the cooperating teachers' sex. Moreover, the continegnecy coefficient ($C = 0.02$) reflects a relatively low and nonsignificant relationship. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science and the cooperating teachers' sex refutes the assumption that preservice elementary science teachers under the supervision of male and female cooperating teachers differ in their attitudes toward science.

Qu_{8-b}

To what degree does a relationship exist between attitudes of Thai preservice elementary science teachers toward science teaching and cooperating teachers' sex?

The failure to reject H_{08-b} does not support the contention that there was a significant relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the cooperating

teachers' sex. Moreover, the contingency coefficient (C = 0.01) reflects a relatively low and nonsignificant relationship. Lack of evidence in confirmation of a relationship between attitudes of Thai preservice elementary science teachers toward science teaching and the cooperating teachers' sex refutes the assumption that preservice teachers under the supervision of male and female cooperating teachers differ in their attitudes toward science teaching.

Finding no significant relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching and the cooperating teachers' sex supported the findings when testing H_{03-a} and H_{03-b}. These findings may indicate that neither male nor felmale cooperating teachers have a more positive effect on attitudes toward science and science teaching of Thai preservice elementary science teachers. The implication of these findings may be that preservice elementary science teachers could be assigned to either male or female cooperating teachers. If the purpose of assigning all preservice elementary science teachers to male cooperating teachers is done to promote attitudes toward science and science teaching, these findings imply the incongruence of this practice.

Recommendations

The following recommendations are made for further study in this area and for those who are involved in science teacher education programs.

1. The results of this study indicate that attitudes of Thai preservice elementary science teachers toward science and science teaching were significantly positive. A replication of this study should be done for other groups of subjects to confirm these results.

2. Based on the results of investigating relationships between attitudes of Thai preservice elementary science teachers toward science and science teaching and six control variables, there were only two variables (type of secondary school and geographic cultural pattern) that showed significant relationship to attitudes toward science. No evidence was found to confirm any relationship between attitudes toward science teaching and the six control variables. A replication of this investigation may produce more conclusive evidence.

3. A study should be undertaken to identify sources of attitudinal differences in attitude toward scicnce: (a) between Thai preservice elementary science teachers who are graduated from public and private secondary schools, and (b) among Thai preservice elementary science teachers from the four geographic cultural patterns.

4. A study could be done to investigate relationships between attitudes of Thai inservice elementary science teachers toward science and science teaching and the following variables: (1) urban/rural location of teaching, (2) geographic cultural pattern, (3) private/public school teaching, (4) inservice teachers' sex, and (5) years of teaching experience. This recommended study may provide evidences supporting the present study. Also, the recommended study may provide useful information for those who are involved in inservice science teacher education programs.

It is the belief of this investigator that a strength of the science teacher education program is the extent to which the program is capable of assisting preservice teachers to become effective science teachers. Thai educators, curriculum specialists, and college science teachers should be aware of the results of this study if the newer science

education programs are going to be implemented effectively. Hopefully, the information necessary for improving and developing the science teacher education program for Thailand will be derived from the results of this study.

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APPENDIX A

HISTORICAL BACKGROUND AND GEOGRAPHIC CULTURAL PATTERNS OF THAILAND

Historical Background and Geographic Cultural Patterns of Thailand

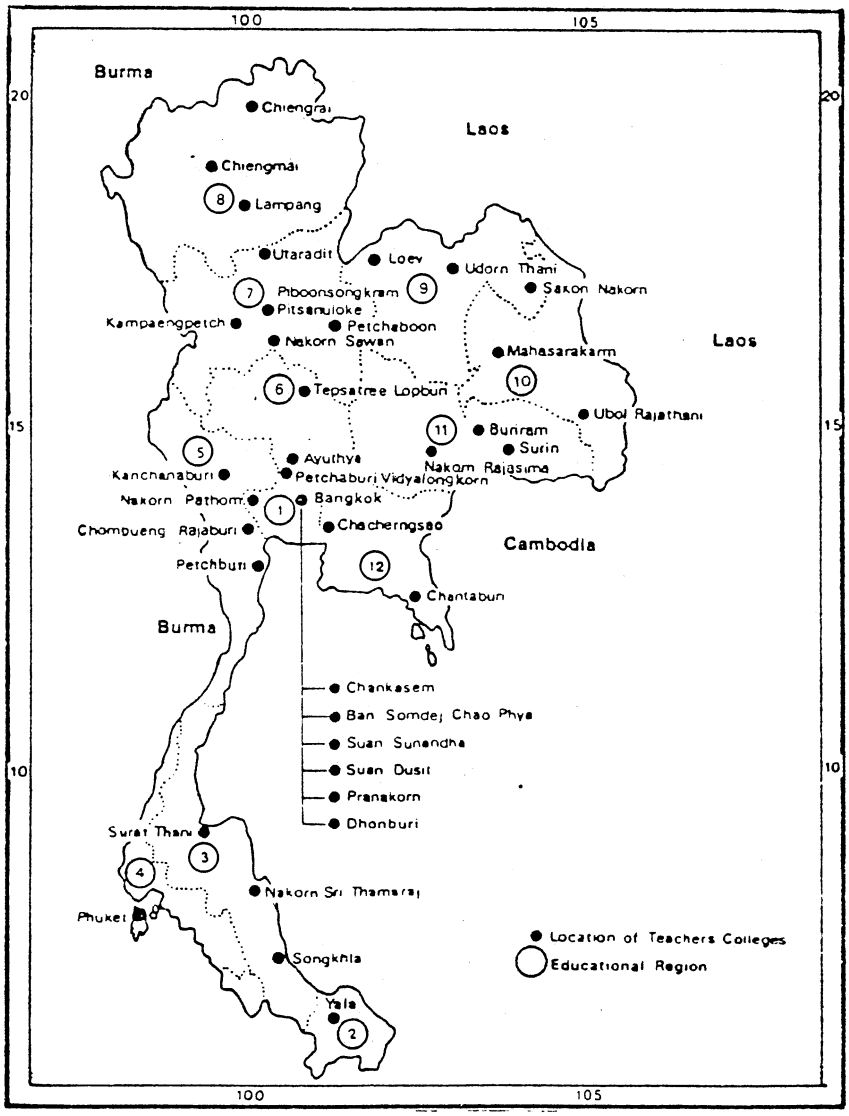
Thailand is located in southeast Asia with Laos and Cambodia to the east, Burma to the west, and Malaysia to the south. The country is divided into four geographic regions: North, Central, Northeast, and South. The Northern region is mountainous, with populated fertile valleys. The principal occupations are associated with rice, teak, soya beans, and tobacco. The Central region, the rich, closely-settled basin of the Cho-Praya, is the political and economic center of the nation, and the former base of the historical Kingdom of Ayudhaya. The Northeastern region is semi-arid, supports cattle raising, and the silk industry. The weather is suitable for upland crops such as maize, kenaf, cotton, and kapok. The South region is a narrow pensinula stretching from the Central Plain to Malaysia. Because of the extensive coastline, fishing and pearl cultivation are the main businesses. The region is also rich in tin and rubber. Mining is an industry along the peninsula coast (Chu, 1968, Hoy Kee, 1973).

Historically, Thai people first appeared in southern China, near the Yantze Valley, to the southeast of the Tibeto-Burman and west of the Yuen. By 650 A. D., the Thais established in Yunnan the independent Kingdom of Nan Chao. During 1000-1100 A. D., the Chinese invaded Nan Chao and absorbed this kingdom into their empire. As a result, the Thais migrated to the region that now is the location of Thailand. Before the migration, most of this region was controlled by Cambodia, also called the Khmer Empire. When Thais outnumbered the original inhabitants, they began to seize political control from them. In 1238, the Kingdom of Sukhothai was established, and the Thai people became unified into a new nation.

Present Thais in four regions tend to differ from each other in their cultural pattern. Culturally, southern Thais are more closely affiliated to the Malays in Malaysia. They speak southern Thai dialect and Malay, the language of the people in Malaysia. The Malay language is distinct from Thai in its linguistic structure and writing system. The northern Thais' culture, customs, and traditions are closely affiliated to those of Burma and Laos. They speak northern Thai dialect. Northeastern Thais have a closer cultural affiliation with Laotians and Cambodians; they speak both Laotian and Cambodian languages. Most of the cultural heritage of this region is from the Khmer Empire. The Central Thais descended from the ancient Sukhothai Kingdom. The language they speak is considered a national language, especially in the dialect of Bangkok, the capital. The culture and tradition of this region are the result of fusion and adaptation from the Indian and Chinese civilizations. Other minority ethnic groups which occur throughout the country are Chinese and Indian (Nach, 1963; Darling, 1971; Johnson, 1978).

APPENDIX B

MAP OF THAILAND



Source: Thailand, Ministry of Education. An Introduction to the Department of Teacher Training. Bangkok: Chongcharoen Press, 1976.

Figure 3. Map of Thailand

APPENDIX C

LETTER TO PARTICIPANTS IN THE STUDY

WITH TRANSLATION

Dear Preservice Teacher:

As a candidate for the Ed.D. Degree in Curriculum and Instruction with major emphasis in science education at Oklahoma State University, Stillwater, Oklahoma, U. S. A., I am gathering data for my doctoral dissertation. Approval for this study to be conducted at teacher training colleges in Thailand has been granted by the Department of Teacher Training, Ministry of Education, Thailand.

You have been selected to assist in providing this information. I would indeed appreciate having you complete the questionnaire according to the directions. Your cooperation and honest responses are vitally important to the success of this study.

Please be assured that your responses to the questionnaire will remain confidential. You will not be identified in the study.

Thank you very much for your time and your assistance with this study.

Sincerely yours,

Khatiya Guntawong

Dr. Ted Mills, Professor
of Science Education,
Thesis Chairman

เรียน นักศึกษาฝึกสอน ป.กศ.สูง

ข้าพเจ้ากำลังทำการศึกษาวิชา การศึกษาวิทยาศาสตร์ ชั้นปริญญาเอก ในภาควิชาหลักสูตร และวิธีสอน ม. Oklahoma State Universityสหรัฐอเมริกา ข้าพเจ้ามีความประสงค์ที่จะขอความช่วยเหลือและร่วมมือจากท่าน เลือกข้อความในแบบสำรวจที่ท่านได้รับ ข้อมูลเหล่านี้จะเป็นประโยชน์อย่างยิ่ง ในการนำไปประกอบการเขียนวิทยานิพนธ์ ขอให้ท่าน เลือกข้อความทุกข้อตามคำแนะนำ ด้านหน้าของแบบสำรวจ และตอบคำถามในแบบสอบถามทั่ว ๆ ไป ความร่วมมือของท่านในการให้ความเป็นจริง อย่างสุจริตใจ เป็นสิ่งที่มีความสำคัญอย่างยิ่งต่อผลสำเร็จ ของการทำวิทยานิพนธ์ในครั้งนี้

หัวข้อของวิทยานิพนธ์ คือ "An Investigative of Preservice Teachers' Attitudes Toward Science and Science Teaching at Teachers' Colleges in Thailand

กรุณามั่นใจได้ว่าคำตอบของท่าน จะถือเป็นความลับ และไม่มีการทำรายละเอียดเกี่ยวกับตัวท่าน ไปอ้างอิงในที่ใด ๆ ข้าพเจ้าขอขอบคุณ ที่ท่านได้สละเวลา ให้ความช่วยเหลือ และร่วมมือกับการสำรวจครั้งนี้ เป็นอย่างยิ่ง

ขอแสดงความนับถือ

ชัชชา กัมพวงศ์

APPENDIX D

PARTICIPANT INFORMATION SHEET WITH TRANSLATION

PARTICIPANT INFORMATION SHEET

Please provide the information about yourself by circling the number and/or filling in the following blanks.

Teacher training college's name . . . . . .

Sex . . . . . I. D. number . . . . . .

Major . . . . . Minor . . . . . .

Number of male and female college science teachers:

No. of males . . . . . .

No. of females . . . . . .

Secondary school attended:

1. public school
2. private school

Location of school where I have completed my student teaching:

1. rural school (population under 70,000)
2. innercity school (population over 70,000)

Grade level taught . . . . . .

Cooperating teacher's sex:

1. male
2. female

แบบสอบถามทั่ว ๆ ไป

๑. วิทยาลัยครู _____

๒. เพศ_____ อายุ_____ เลขประจำตัว นศ. _____
(สำคัญมาก)

๓. วิชาเอก _____ วิชาโท _____

๔. สำเร็จมัธยมศึกษาจาก โรงเรียนรัฐบาล _____
โรงเรียนราษฎร์ _____

๕. จำนวนอาจารย์วิทยาศาสตร์ ที่สอนมาทั้งหมด (เฉพาะในวิทยาลัยครู)
มีจำนวน _____ ท่าน
เพศ หญิง _____ ท่าน
ชาย _____ ท่าน

๖. ทำการฝึกสอนที่โรงเรียน ชนบท ☐ ชั้น _____
ในเมือง ☐

๗. ครูพี่เลี้ยงเพศ ☐ หญิง ☐ ชาย

๘. ท่านทำเครื่องหมายแบบสอบถามนี้เมื่อ ก่อนการฝึกสอน ☐
สำเร็จการฝึกสอน ☐

APPENDIX E

SCIENCE TEACHING ATTITUDE SCALES AND ANSWER SHEET WITH ORIGINAL AND REVISED TRANSLATIONS

PLEASE NOTE:

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These consist of pages:

110-129

University Microfilms International

300 N. ZEEB RD., ANN ARBOR, MI 48106 (313) 761-4700

WHAT IS YOUR ATTITUDE TOWARD SCIENCE

AND SCIENCE TEACHING?

There are some statements about science and science teaching on the next few pages. Some statements are about a person's feeling about science. Some of these statements describe views about how science should be taught. You may agree with some of the statements and you may disagree with others. That is exactly what you are asked to do. By doing this, you will show your attitudes toward science and science teaching.

After you have carefully read a statement, decide whether you agree or disagree with it. If you agree, decide whether you agree mildly or strongly. If you disagree, decide whether you disagree mildly or strongly. Then, find the number of that statement on the answer sheet, and blacken the space by the

1 if you agree strongly

2 if you agree mildly

3 if you disagree mildly

4 if you disagree strongly

Example:

00. I would like to have many friends

00. 1  2  3  4 

(The person who marked this example agrees strongly with the statement, "I would like to have many friends.")

Please respond to each statement and mark only <u>one</u> space for each statement.

Please do not make any marks on this test booklet.

WHAT IS YOUR ATTITUDE TOWARD SCIENCE AND

SCIENCE TEACHING?

1. It is important for children to learn that the air is approximately 20% oxygen--at least by the sixth grade.
2. There is no need for the public to understand science in order for scientific progress to occur.
3. Most children should be able to design experiments--at least by the sixth grade.
4. Most people are not able to understand the work of science.
5. When something is explained well, there is no reason to look for another explanation.
6. A teacher should be a resource person rather than information-giver in science.
7. The products of scientific work are mainly useful to scientists; they are not very useful to the average person.
8. I do not understand science, and I do not want to teach it.
9. A scientist must be imaginative in developing ideas which explain natural events.
10. After all is said and done, it is really the teacher who tells the children what they have to learn and know.
11. Some questions cannot be answered by science.
12. In teaching science, a teacher might spend more time listening to children than talking to them.
13. Before one can do anything in science, he must study the writings of the great scientists.
14. Rapid progress in science requires public support.
15. Process skills are very important things to be developed in science.
16. Scientists believe that nothing is known to be true with absolute certainty.
17. A major purpose of science is to help man live more comfortably.
18. A new theory may be accepted when it can be shown to explain things as well as another theory.
19. Children must learn certain basic facts in elementary science so they can do well in science in junior high.
20. Scientists do not need public support; they can get along quite well without it.
21. I understand science and I want to teach it.
22. Every citizen should understand science because we are living in an age of science.

23. Children must be told what they are to learn if they are to make progress in science.
24. Science is so difficult that only highly trained scientists can understand it.
25. A teacher has a responsibility to teach the basic processes of science.
26. His senses are one of the most important tools a scientist has.
27. Science may be described as being primarily an idea-generating activity.
28. Ideas are one of the more important products of science.
29. As children experiment, a teacher may give helpful hints, but not the answer to a problem.
30. Science is pretty easy to understand.
31. The value of science lies in its theoretical products.
32. Process skills are the most important things to be developed by children in science.
33. A major purpose of science is to produce new drugs and save lives.
34. I like science, and I probably will be (am) a better science teacher than most other teachers.
35. Science is devoted to describing how things happen.
36. I am afraid to teach science because I can't do the experiments myself.
37. Public understanding of science is necessary because scientific research requires financial support through the government.
38. I just never will understand science.
39. People need to understand the nature of science because it has such a great effect upon their lives.
40. A teacher has a responsibility to teach the basic facts of science.
41. Scientists discover laws which tell us exactly what is going on in nature.
42. The idea of teaching science scares me.
43. Demonstrations should be used frequently so the children will understand what their teacher tells them.
44. Scientists believe that they can find explanations for what they observe by looking at natural phenomena.
45. Scientific laws cannot be changed.
46. If an experiment does not come out right, the teacher should tell the children the answer so they will not be lost.
47. There are some things which are known by science to be absolutely true.
48. It is a teacher's responsibility to tell children which things are important for them to know.
49. I do (will) not teach very much science.
50. An important purpose of science is to help man to live longer.

51. A useful scientific theory may not be entirely correct, but it is the best idea scientists have been able to think up.
52. Today's electric appliances are examples of the really valuable products of science.
53. It is important for children to learn how to control variables in an experiment--at least by the sixth grade.
54. I am well-prepared to teach science.
55. The teacher should arrange things so that children spend more time experimenting than listening to her in science.
56. Scientists are always interested in improving their explanations of natural events.
57. The value of science lies in its usefulness in solving practical problems.
58. I think I understand the nature of science and science teaching pretty well.
59. Most people are able to understand the work of science.
60. Scientific explanations can be made only by scientists.
61. Most children should know that the blood carries oxygen to the cells --at least by the sixth grade.
62. We can always get answers to our questions by asking a scientist.
63. Scientific laws have been proven beyond all possible doubt.
64. Looking at natural phenomena is a most important source of scientific information.
65. A major function of the teacher in teaching science is to help children identify problems.
66. If a sicentist cannot answer a question, all he has to do is to ask another scientist.
67. Anything we need to know can be found out through science.
68. It is important for children to know why iron rusts--at least by the sixth grade.
69. Scientific ideas may be said to undergo a process of evolution in their development.
70. Scientists cannot always find the answer to their questions.

Statement	1 Agree strongly	Agree mildly	2 Disagree mildly	3 Disagree strongly	4
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					

Statement	1 Agree strongly	Agree mildly	2 Disagree mildly	3 Disagree strongly	4
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					

Statement	1 Agree strongly	Agree mildly	2 Disagree mildly	3 Disagree strongly	4
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
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62					
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64					
65					
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67					
68					
69					
70					

	๑	๒	๓	๔
๑. เด็กนักเรียนควรจะเรียนรู้ว่ามีอ๊อกซิเจนอยู่ในอากาศ อย่างช้าที่สุดชั้นประถมหก				
๒. สำหรับคนทั่วไปไม่รู้เป็นจะต้องเข้าใจวิทยาศาสตร์ในการที่จะทำให้วิทยาศาสตร์ก้าวหน้าขึ้น				
๓. เด็กนักเรียนส่วนใหญ่ควรจะสามารถคิดทำการทดลองเองได้ อย่างช้าที่สุดชั้นประถมหก				
๔. คนส่วนใหญ่ไม่สามารถที่จะเข้าใจหลักการทำงานของวิทยาศาสตร์				
๕. ไม่มีความจำเป็นอะไรที่จะต้องหาคำอธิบายอื่นๆอีกสำหรับสิ่งที่มีคำอธิบายก็อยู่แล้ว				
๖. ครูวิทยาศาสตร์ควรจะเป็นแหล่งวิทยาการและรู้จักกำหนดการเรียนการสอนมากกว่าที่จะเป็นแค่ผู้สอนเท่านั้น				
๗. ผลงานต่างๆทางวิทยาศาสตร์ส่วนใหญ่มีประโยชน์ต่อนักวิทยาศาสตร์มากกว่ากับคนทั่วๆไป				
๘. ข้าพเจ้าไม่เข้าใจวิทยาศาสตร์และไม่ต้องการที่จะสอนวิทยาศาสตร์				
๙. นักวิทยาศาสตร์จะต้องมีความคิดและจินตนาการเพื่อที่จะหาคำอธิบายปรากฏการณ์ทางธรรมชาติที่เกิดขึ้น				
๑๐. สรุปแล้ว ครูเท่านั้นที่เป็นผู้กำหนดว่านักเรียนควรจะเรียนรู้ในเรื่องใดบ้าง				
๑๑. ปัญหาบางอย่างไม่สามารถจะอธิบายได้ด้วยวิทยาศาสตร์				
๑๒. ในการสอนวิทยาศาสตร์ ครูอาจจะใช้เวลาส่วนใหญ่ฟังความคิดเห็น คำพูดของนักเรียนมากกว่าที่จะเป็นผู้พูดกับนักเรียน				
๑๓. ก่อนที่ใครจะทำอะไรทางวิทยาศาสตร์ เขาควรจะศึกษาข้อเขียนของนักวิทยาศาสตร์ที่มีชื่อเสียงก่อน				
๑๔. การที่วิทยาศาสตร์จะก้าวหน้าได้อย่างรวดเร็วจะต้องได้รับการสนับสนุนจากคนทั่วไป				

	๑	๒	๓	๔
๑๕. ความสำนึกในแต่ละขั้นตอนทางวิทยาศาสตร์ เช่นความสำนึกในการสังเกต ความสำนึกในการวิเคราะห์ ความสำนึกในการจัดกลุ่ม และความสำนึกในการตั้งสมมุติฐาน เป็นสิ่งสำคัญมากในการที่จะศึกษาวิทยาศาสตร์				
๑๖. นักวิทยาศาสตร์เชื่อว่าไม่มีสิ่งใดที่ถูกต้องอย่างแท้จริง				
๑๗. จุดประสงค์ใหญ่ของวิทยาศาสตร์คือช่วยให้มนุษย์มีความเป็นอยู่อย่างสุขสบาย				
๑๘. ทฤษฎีใหม่ๆก็อาจเป็นที่ยอมรับได้ถ้าทฤษฎีนั้นให้คำอธิบายที่ดีเทียบกับทฤษฎีอื่นๆที่มีอยู่แล้ว				
๑๙. เด็กควรจะมีความรู้ขั้นพื้นฐานทางวิทยาศาสตร์จากชั้นประถมเพื่อที่จะได้มีความเข้าใจในวิทยาศาสตร์ดีขึ้นเมื่อขึ้นชั้นมัธยม				
๒๐. นักวิทยาศาสตร์ไม่จำเป็นต้องอาศัยการสนับสนุนจากคนทั่วไปเพราะนักวิทยาศาสตร์สามารถจะทำงานในกลุ่มของคนได้				
๒๑. ข้าพเจ้าเข้าใจในวิทยาศาสตร์และต้องการที่จะสอนวิทยาศาสตร์				
๒๒. ประชาชนทุกคนควรจะเข้าใจวิทยาศาสตร์เพราะว่าทุกคนอยู่ในยุคของวิทยาศาสตร์				
๒๓. นักเรียนควรจะได้รับคำแนะนำว่าจะต้องเรียนรู้อะไรเพื่อที่จะช่วยให้นักเรียนมีความก้าวหน้าทางวิทยาศาสตร์เพิ่มขึ้น				
๒๔. วิทยาศาสตร์เป็นวิชาที่ยากมาก นักวิทยาศาสตร์ที่ศึกษามาทางนี้โดยเฉพาะเท่านั้นที่จะเข้าใจได้				
๒๕. ครูมีความรับผิดชอบที่จะต้องสอนความรู้ขั้นพื้นฐานทางวิทยาศาสตร์				
๒๖. เครื่องมือที่สำคัญที่สุดของนักวิทยาศาสตร์คือความมีสัญชาตญาณในการนึกคิด				
๒๗. วิทยาศาสตร์อาจจะหมายถึงกิจกรรมที่หัดให้ใช้ความคิดเป็นจุดเริ่มต้น				
๒๘. ความคิดถือว่าเป็นผลผลิตที่สำคัญกว่าผลผลิตชนิดอื่นๆที่ได้จากวิทยาศาสตร์				
๒๙. ในขณะที่นักเรียนทำการทดลองอยู่ ครูอาจจะช่วยแนะให้บ้างแต่ไม่ใช่ให้คำตอบแก่นักเรียน				
๓๐. วิทยาศาสตร์เป็นวิชาที่เข้าใจง่าย				

	๑	๒	๓	๔
๓๑. คุณค่าของวิทยาศาสตร์ขึ้นอยู่กับผลิตผลที่ได้จากทฤษฎีทางวิทยาศาสตร์				
๓๒. ความชำนาญในแต่ละขั้นตอน เช่นความชำนาญในการสังเกต ความชำนาญในการวิเคราะห์ ความชำนาญในการจัดกลุ่ม และความชำนาญในการตั้งสมมุติฐาน เป็นสิ่งที่สำคัญที่สุดที่นักเรียนวิทยาศาสตร์จะต้องพัฒนาให้ก้าวหน้า				
๓๓. จุดประสงค์ที่สำคัญของวิทยาศาสตร์คือการผลิตยาใหม่ๆและการช่วยชีวิตมนุษย์				
๓๔. ข้าพเจ้าชอบวิทยาศาสตร์และคิดว่าข้าพเจ้าสามารถเป็นครูวิทยาศาสตร์ที่ดีกว่าครูคนอื่นๆได้				
๓๕. วิทยาศาสตร์เน้นในทางอธิบายว่าเหตุใดสิ่งต่างๆจึงเกิดขึ้นได้				
๓๖. ข้าพเจ้ากลัวที่จะต้องสอนวิทยาศาสตร์ เพราะข้าพเจ้าเองก็ไม่สามารถที่จะทำการทดลองทางวิทยาศาสตร์ได้				
๓๗. การให้สังคมเข้าใจในวิทยาศาสตร์เป็นสิ่งจำเป็นเพราะว่าการทดลองทางวิทยาศาสตร์จะต้องได้รับความสนับสนุนทางการเงินผ่านทางรัฐบาล				
๓๘. ข้าพเจ้าไม่มีทางที่จะเข้าใจวิทยาศาสตร์ได้				
๓๙. ทุกคนควรจะเข้าใจความเป็นไปทางวิทยาศาสตร์ เพราะว่าวิทยาศาสตร์มีอิทธิพลต่อชีวิตความเป็นอยู่ของมนุษย์				
๔๐. ครูมีความรับผิดชอบในการสอนพื้นฐานความเป็นจริงทางวิทยาศาสตร์				
๔๑. นักวิทยาศาสตร์เป็นผู้ค้นพบกฎต่างๆที่ช่วยอธิบายวิธีการทางธรรมชาติได้				
๔๒. ความคิดที่ว่าจะต้องสอนวิทยาศาสตร์ก็สามารถทำให้ข้าพเจ้ากลัวได้				
๔๓. การอธิบายโดยการทำให้นักเรียนดูบ่อยๆจะช่วยให้เด็กเข้าใจได้ว่าครูกำลังพูดถึงอะไร				
๔๔. นักวิทยาศาสตร์เชื่อว่าเขาจะค้นพบคำอธิบายในสิ่งที่เขาสังเกตการณ์ได้โดยใช้การศึกษาดูจากปรากฏการณ์ทางธรรมชาติ				
๔๕. กฎทางวิทยาศาสตร์ไม่มีการเปลี่ยนแปลง				

	๑	๒	๓	๔
๔๖. ถ้าการทำการทดลองไม่ได้ผลอย่างที่ควรจะได้ ครูควรจะบอกให้นักเรียนทราบถึงผลที่ควรจะได้อย่างแท้จริงเพื่อนักเรียนจะได้ไม่เสียใจมาก				
๔๗. บางสิ่งบางอย่างที่นักวิทยาศาสตร์คนหนึ่งเป็นสิ่งที่ถูกต้องจริงแท้				
๔๘. ครูเป็นผู้ที่มีความรับผิดชอบในการที่จะบอกเด็กนักเรียนว่าสิ่งใดที่สำคัญที่ควรจะเรียนรู้ไว้				
๔๙. ข้าพเจ้าไม่ได้สอน (จะไม่สอน) วิทยาศาสตร์มากนัก				
๕๐. จุดประสงค์ที่สำคัญของวิทยาศาสตร์คือช่วยให้มนุษย์มีชีวิตยืนยาวขึ้น				
๕๑. ทฤษฎีทางวิทยาศาสตร์ที่มีประโยชน์ไม่จำเป็นต้องถูกต้องแท้จริงทั้งหมด มันอาจเป็นแต่เพียงความคิดที่ดีที่สุดที่นักวิทยาศาสตร์สามารถคิดขึ้นได้				
๕๒. เครื่องใช้ไฟฟ้าในปัจจุบันเป็นตัวอย่างอันหนึ่งที่แสดงให้เห็นถึงผลิตผลที่มีคุณค่าของวิทยาศาสตร์				
๕๓. เด็กอย่างน้อยที่สุดชั้นประถมควรจะเรียนรู้ถึงการควบคุมตัวแปรในการทดลองได้				
๕๔. ข้าพเจ้าได้รับการอบรมมาอย่างดีในการสอนวิทยาศาสตร์				
๕๕. ครูวิทยาศาสตร์ควรจะให้เด็กนักเรียนได้มีโอกาสที่จะทำการทดลองแทนที่จะต้องใช้เวลาส่วนใหญ่ฟังคำอธิบายของครูอย่างเดียว				
๕๖. นักวิทยาศาสตร์สนใจที่จะดัดแปลงคำอธิบายปรากฏการณ์ทางธรรมชาติให้ดีขึ้น				
๕๗. ประโยชน์ของวิทยาศาสตร์อยู่ที่การนำมาใช้ในการแก้ปัญหาที่เกิดขึ้น				
๕๘. ข้าพเจ้าคิดว่าข้าพเจ้าเข้าใจธรรมชาติของวิทยาศาสตร์และการสอนวิทยาศาสตร์ดีอยู่แล้ว				
๕๙. คนส่วนใหญ่สามารถทำความเข้าใจกับผลงานทางวิทยาศาสตร์ได้				
๖๐. นักวิทยาศาสตร์เท่านั้นที่สามารถอธิบายเรื่องราวทางวิทยาศาสตร์ได้				
๖๑. นักเรียนส่วนใหญ่ควรจะรู้ว่าเลือดเป็นตัวนำออกซิเจนไปสู่เซลล์อย่างช้าที่สุดชั้นประถมหก				
๖๒. เรามักจะได้คำตอบเสมอเมื่อเราถามนักวิทยาศาสตร์				

	๑	๒	๓	๔
๖๓. กฎทางวิทยาศาสตร์ได้ถูกทดสอบแล้วและเป็นจริงโดยไม่มีข้อสงสัย				
๖๔. แหล่งสำคัญที่ให้เรื่องราวข้อมูลแก่นักวิทยาศาสตร์คือการสังเกตการณ์จากปรากฏการณ์ธรรมชาติ				
๖๕. หน้าที่ของครูวิทยาศาสตร์ที่สำคัญคือช่วยให้นักเรียนเข้าใจว่าอะไรคือปัญหาและการแก้ไขปัญหานั้น				
๖๖. ถ้านักวิทยาศาสตร์ผู้ใหญ่หนึ่งไม่สามารถแก้ปัญหาได้ สิ่งที่เขาทำคือเพียงแค่ถามนักวิทยาศาสตร์ผู้อื่น				
๖๗. ทุกสิ่งทุกอย่างที่เราใครจะเรียนรู้ สามารถหาได้โดยใช้วิทยาศาสตร์เป็นเครื่องช่วย				
๖๘. นักเรียนควรจะรู้ว่าทำไมเหล็กถึงขึ้นสนิม อย่างช้าที่สุดชั้นประถมหก				
๖๙. อาจจะกล่าวได้ว่าแนวความคิดทางวิทยาศาสตร์มีการเปลี่ยนแปลงในขณะเดียวกับการวิวัฒนาการทางวิทยาศาสตร์				
๗๐. นักวิทยาศาสตร์เองก็ไม่สามารถหาคำตอบให้ปัญหาต่างๆได้เสมอไป				

กระดาษคำตอบ เลขประจำตัว นศ. _____

ข้อความ	ไม่แน่ใจ 1	เห็นด้วย 2	ค่อนข้างเห็นด้วย 3	เห็นด้วยอย่างยิ่ง 4
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ข้อความ	เห็นด้วย 1	ค่อนข้างเห็นด้วย 2	ไม่แน่ใจ 3	ค่อนข้างไม่เห็นด้วย 4	ไม่เห็นด้วยอย่างยิ่ง 5
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ข้อความ	เห็นด้วย 1	ค่อนข้างเห็นด้วย 2	ไม่แน่ใจ 3	ค่อนข้างไม่เห็นด้วย 4	ไม่เห็นด้วยอย่างยิ่ง 5
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แบบสำรวจทัศนคติที่มีต่อ วิทยาศาสตร์ และวิธีสอน วิทยาศาสตร์

แบบสำรวจชุดนี้ เป็นข้อความเกี่ยวกับทัศนคติของท่านต่อวิทยาศาสตร์ และวิธีสอนวิทยาศาสตร์ โปรดอ่านแต่ละข้อความอย่างละเอียด แล้วขีดเครื่องหมาย (✓) เพียงหนึ่งเครื่องหมาย สำหรับแต่ละข้อความ ลงในช่องตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด ในกระดาษคำตอบ

แบบสำรวจชุดนี้มีทั้งหมด 70 ข้อ หมายเลขที่ท่านจะเลือกมี 4 หมายเลข

หมายเลข 1	หมายถึง	เห็นด้วยอย่างมาก
หมายเลข 2	หมายถึง	เห็นด้วย
หมายเลข 3	หมายถึง	ไม่เห็นด้วย
หมายเลข 4	หมายถึง	ไม่เห็นด้วยอย่างมาก

ตัวอย่างเช่น

	1	2	3	4
ข้าพเจ้าชอบเล่นกีฬา	✓			

(บุคคลที่ทำตัวอย่างอันนี้เห็นด้วยอย่างมากกับข้อความในตัวอย่าง)

* กรุณาอย่าทำเครื่องหมายหรือขีดเขียนข้อความใด ๆ ลงในตัวแบบสำรวจ

ท่านมีวิธีคิดอย่าง วิทยาศาสตร์
และวิธีสอนวิทยาศาสตร์ อย่างไร

1. นักเรียนควรจะเรียนรู้ว่าอากาศมีออกซิเจนเป็นองค์ประกอบอยู่ 20% อย่างช้าที่สุดตั้งแต่ชั้นประถมหก
2. ไม่มีความจำเป็นที่คนทั่วไป จะต้องเข้าใจในวิทยาศาสตร์ เพื่อให้เกิดความก้าวหน้าในทางวิทยาศาสตร์
3. นักเรียนส่วนใหญ่ควรจะสามารถคิดทำการทดลองเองได้ อย่างช้าที่สุดตั้งแต่ชั้นประถมหก
4. คนส่วนใหญ่ไม่สามารถที่จะเข้าใจในงานทางด้านวิทยาศาสตร์
5. ไม่มีความจำเป็นใด ๆ ที่จะต้องคิดหาคำอธิบายอื่นอีกสำหรับสิ่งที่มีคำอธิบายคือยู่แล้ว
6. ครูวิทยาศาสตร์ควรจะเป็นแหล่งวิทยาการให้เด็กมาสอบถาม มากกว่าที่จะเป็นผู้บรรยายเอง
7. ผลงานต่าง ๆ ทางวิทยาศาสตร์ส่วนใหญ่มีประโยชน์ต่อนักวิทยาศาสตร์มากกว่าคนทั่ว ๆ ไป
8. ข้าพเจ้าไม่เข้าใจวิทยาศาสตร์ และไม่ต้องการที่จะสอนวิชาวิทยาศาสตร์
9. นักวิทยาศาสตร์จะต้องมีจินตนาการในการคิดหาคำอธิบายปรากฏการณ์ทางธรรมชาติที่เกิดขึ้น
10. สรุปแล้ว ครูเท่านั้นที่เป็นผู้กำหนดว่านักเรียนควรจะเรียนรู้ในเรื่องใดบ้าง
11. ปัญหาบางอย่างไม่สามารถจะให้คำอธิบายได้ด้วยวิทยาศาสตร์
12. ในการสอนวิทยาศาสตร์ ครูควรจะใช้เวลาส่วนใหญ่ฟังความคิดเห็นจากนักเรียนมากกว่าที่จะเป็นฝ่ายพูดกับนักเรียน
13. ก่อนที่ใครจะกระทำสิ่งใดในทางวิทยาศาสตร์ เขาควรจะศึกษาข้อเขียนของนักวิทยาศาสตร์ที่มีชื่อเสียงก่อน
14. การที่วิทยาศาสตร์จะเจริญก้าวหน้าอย่างรวดเร็วได้ จะต้องได้รับการสนับสนุนจากคนทั่วไป
15. การเสริมสร้างทักษะในการปฏิบัติ ตามขบวนการของวิทยาศาสตร์ เช่น การสังเกต การตั้งสมมุติฐาน การจำแนกแยกแยะ การวิเคราะห์ ถือว่าเป็นสิ่งที่สำคัญมาก
16. นักวิทยาศาสตร์มีความเชื่อว่า ไม่มีสิ่งใดที่ถูกต้องอย่างแท้จริง
17. จุดประสงค์ใหญ่ของวิทยาศาสตร์คือช่วยให้มนุษย์มีความเป็นอยู่อย่างสุขสบาย
18. หลักฐานใหม่ ๆ ก็อาจเป็นที่ยอมรับได้ถ้าหลักฐานนั้นให้คำอธิบายได้ดีเท่ากับหลักฐานอื่น ๆ ที่มีอยู่แล้ว
19. นักเรียนควรจะมีความรู้พื้นฐานทางวิทยาศาสตร์จากชั้นประถมเพื่อที่จะได้มีความเข้าใจในวิทยาศาสตร์ดียิ่งขึ้นเมื่อขึ้นชั้นมัธยม
20. นักวิทยาศาสตร์สามารถดำเนินงานเองได้ตามลำพัง ไม่ต้องอาศัยการสนับสนุนจากคนทั่วไป

21. ข้าพเจ้าเข้าใจในวิทยาศาสตร์ และมีความประสงค์ที่จะสอนวิทยาศาสตร์
22. ประชาชนทุกคนควรจะเข้าใจวิทยาศาสตร์ เพราะว่าทุกคนอยู่ในยุควิทยาศาสตร์
23. นักเรียนจะต้องมารับคำแนะนำจากครูว่าเขาต้องเรียนรู้อะไร ถ้าเขาอยากจะเพิ่มความก้าวหน้าทางวิทยาศาสตร์
24. วิทยาศาสตร์เป็นวิชาที่ยากมาก นักวิทยาศาสตร์ที่ได้รับการศึกษาสูง ๆ มาเท่านั้น ที่สามารถจะเข้าใจได้
25. ครูมีความรับผิดชอบในการสอน ขบวนการของวิทยาศาสตร์ ในขั้นพื้นฐาน
26. ประสาทสัมผัสเป็นหนึ่งในบรรดาเครื่องมือที่สำคัญมากที่นักวิทยาศาสตร์มีอยู่
27. อาจให้ความหมาย วิทยาศาสตร์ว่าเป็นกิจกรรมของการฝึกหัดสร้างสรรค์ความคิด ในเบื้องต้น
28. ความคิด จัดว่าเป็นหนึ่งในบรรดาผลผลิตสำคัญจากวิทยาศาสตร์
29. ในขณะที่นักเรียนกำลังทำการทดลองอยู่ ครูอาจจะช่วยแนะให้บ้าง แต่ไม่ใช่บอกผลการทดลองแก่นักเรียน
30. วิทยาศาสตร์เป็นวิชาที่เข้าใจง่าย
31. คุณค่าของวิทยาศาสตร์ อยู่ที่ผลิตผลทางทฤษฎีของวิทยาศาสตร์
32. ทักษะในการปฏิบัติตาม ขบวนการทางวิทยาศาสตร์ เช่น การตั้งคำถาม การจำแนกแยกแยะ การสังเกต การวิเคราะห์ ถือว่าเป็นสิ่งสำคัญสำหรับนักเรียนที่เรียนวิทยาศาสตร์จะต้องพัฒนา
33. จุดประสงค์ใหญ่ของวิทยาศาสตร์คือการผลิตยาใหม่ ๆ และการช่วยชีวิตมนุษย์
34. ข้าพเจ้าชอบวิทยาศาสตร์ และคิดว่าข้าพเจ้าคงจะเป็น ครูวิทยาศาสตร์ที่ดีกว่าคนอื่น ๆ
35. วิทยาศาสตร์ ว่าด้วยการอธิบายว่าสิ่งต่าง ๆ เกิดขึ้นได้อย่างไร
36. ข้าพเจ้ากลัวที่จะต้องสอนวิทยาศาสตร์ เพราะข้าพเจ้าเองไม่สามารถที่จะทำการทดลองวิทยาศาสตร์ได้
37. การให้สังคมเข้าใจในวิทยาศาสตร์เป็นสิ่งจำเป็นเพราะว่าการทดลองทางวิทยาศาสตร์จะต้องได้รับความสนับสนุนทางการเงินจากทางรัฐบาล
38. ข้าพเจ้าไม่มีทางที่จะเข้าใจวิทยาศาสตร์ได้
39. ทุกคนควรจะเข้าใจธรรมชาติของวิทยาศาสตร์ เพราะว่าวิทยาศาสตร์มีอิทธิพลต่อชีวิตความเป็นอยู่ของมนุษย์
40. ครูมีความรับผิดชอบในการสอนข้อเท็จจริง พื้นฐานทางวิทยาศาสตร์
41. นักวิทยาศาสตร์เป็นผู้ค้นพบกฎต่าง ๆ ที่ช่วยให้เราหาความเข้าใจในธรรมชาติ
42. ความคิดที่ว่า จะต้องสอนวิทยาศาสตร์ต่อไปภายหน้า ทำให้ข้าพเจ้ารู้สึกกลัว
43. ในระหว่างการสอน ครูควรจะสาธิตให้นักเรียนดูบ่อย ๆ เพื่อนักเรียนจะได้เข้าใจว่าครูกำลังพูดเรื่องอะไร
44. นักวิทยาศาสตร์เชื่อว่าเขาจะหาคำอธิบายในสิ่งที่เขาสังเกตการณ์ได้โดยใช้การศึกษาจากปรากฏการณ์ทางธรรมชาติ

45. กฎทางวิทยาศาสตร์ จะไม่มีการเปลี่ยนแปลง
46. ถ้าการทำการทดลองไม่ได้ผลตามที่ควรจะได้ ครูควรจะบอกให้นักเรียนทราบถึงผลที่ควรจะได้อย่างแท้จริง เพื่อที่นักเรียนจะได้ไม่สับสน
47. มีบางสิ่งบางอย่าง ซึ่งเป็นที่รับรู้กันในทางวิทยาศาสตร์ ว่าถูกต้องอย่างสมบูรณ์
48. ครูเป็นผู้ที่มีความรับผิดชอบในการเป็นผู้บอกนักเรียนว่าสิ่งใดสำคัญที่ควรจะเรียนรู้ไว้
49. ข้าพเจ้าไม่ได้สอน (จะไม่สอน) วิทยาศาสตร์มากนัก
50. จุดประสงค์ที่สำคัญของวิทยาศาสตร์คือช่วยให้มนุษย์มีชีวิตยืนยาวขึ้น
51. หลักฐานทางวิทยาศาสตร์ที่มีประโยชน์ไม่จำเป็นต้องถูกต้องแท้จริงหมด เป็นแต่เพียงความคิดที่ดีที่สุด เท่าที่นักวิทยาศาสตร์สามารถคิดขึ้นได้
52. เครื่องใช้ไฟฟ้าในปัจจุบันเป็นตัวอย่างอันหนึ่งที่แสดงให้เห็นถึงผลิตผลที่มีคุณค่าของวิทยาศาสตร์
53. นักเรียนควรจะเรียนรู้ ถึงการควบคุมตัวแปรในการทดลอง อย่างช้าที่สุดตั้งแต่ชั้นประถมหก
54. ข้าพเจ้าได้รับการอบรมมาอย่างดีในการสอนวิทยาศาสตร์
55. ครูวิทยาศาสตร์ควรจะให้นักเรียน ใช้เวลาส่วนใหญ่ในการทำการทดลอง แทนที่จะนั่งฟังการบรรยายของครู
56. นักวิทยาศาสตร์สนใจที่จะดัดแปลงแก้ไขคำอธิบายปรากฏการณ์ทางธรรมชาติ ให้ดีขึ้นเสมอ
57. คุณค่าของวิทยาศาสตร์อยู่ที่ประโยชน์ในการนำมาใช้แก้ปัญหาที่เกิดขึ้นจริง ๆ
58. ข้าพเจ้าคิดว่าข้าพเจ้าเข้าใจธรรมชาติของวิทยาศาสตร์ และการสอนวิทยาศาสตร์ค่อนข้างดี
59. คนส่วนใหญ่สามารถทำความเข้าใจกับผลงานทางวิทยาศาสตร์ได้
60. นักวิทยาศาสตร์เท่านั้นที่สามารถอธิบายเรื่องราวทางวิทยาศาสตร์ได้
61. นักเรียนส่วนใหญ่ควรจะรู้ว่าเลือกเป็นตัวนำออกซิเจนไปสู่เซลล์อย่างช้าที่สุดตั้งแต่ชั้นประถมหก
62. นักวิทยาศาสตร์สามารถจะให้คำตอบต่อคำถามของเราได้เสมอ
63. กฎทางวิทยาศาสตร์ได้รับการพิสูจน์ข้อโต้แย้งทั้งหมดแล้ว
64. แหล่งสำคัญที่ให้ความรู้ ข้อมูลทางวิทยาศาสตร์คือการสังเกตการณ์จาก ปรากฏการณ์ธรรมชาติ
65. หน้าที่ของครูวิทยาศาสตร์ที่สำคัญ คือการช่วยนักเรียนหาความเข้าใจกับปัญหาและช่วยแนะการแก้ปัญหา
66. ถ้านักวิทยาศาสตร์ผู้ใดไม่สามารถแก้ปัญหาได้ สิ่งที่เขาจะทำได้คือไปถามนักวิทยาศาสตร์อีกผู้หนึ่ง
67. สิ่งใดที่เราใคร่จะเรียนรู้ จะสามารถหาได้โดยใช้วิทยาศาสตร์เป็นเครื่องช่วย
68. นักเรียนควรจะเรียนรู้ว่าทำไมเหล็กจึงขึ้นสนิม อย่างช้าที่สุดชั้นประถมหก
69. อาจจะกล่าวได้ว่า แนวความคิดทางวิทยาศาสตร์มีการเปลี่ยนแปลงไปพร้อมกับการวิวัฒนาการทางวิทยาศาสตร์
70. นักวิทยาศาสตร์เองก็ไม่สามารถหาคำตอบให้ปัญหาต่าง ๆ ได้เสมอไป

APPENDIX F

SCORING KEY FOR RESPONSES ON SCIENCE TEACHING ATTITUDE SCALES

Scale	Attitudes Assessed by "What is Your Attitude Toward Science and Science Teaching?"	Items Used Each Attitude
1-Pos.	The laws and/or theories of science are approximations of truth and are subject to change.	16,18,51,56,69
1-Neg.	The laws and/or theories of science represent unchangeable truths discovered through science.	5,41,45,47,63
2-Pos.	Observation of natural phenomena is the basis of scientific explanation. Science is limited in that it can only answer questions about natural phenomena and sometimes it is not able to do that.	11,26,44,64,70
2-Neg.	The basis of scientific explanation is in authority. Science deals with all problems and it can provide correct answers to all questions.	13,60,62,66,67
3-Pos.	Science is an idea-generating activity. It is devoted to providing explanations of natural phenomena. Its value lies in its theoretical aspects.	9,27,28,31,35
3 Neg.	Science is a technology-developing activity. It is devoted to serving mankind. Its value lies in its practical uses.	17,33,50,52,57
4-Pos.	Progress in science requires public support in this age of science; therefore, the public should be made aware of the nature of science and what it attempts to do. The public can understand science and it ultimately benefits from scientific work.	14,22,37,39,59
4-Neg.	Public understanding of science would contribute nothing to the advancement of science or to human welfare; therefore, the public has no need to understand the nature of science. They cannot understand it, and it does not affect them.	2, 4, 7, 20,24
5-Pos.	The idea of teaching science is attractive to me; I understand science and I can teach it.	21,30,34,54,58
5-Neg.	I do not like the thought of teaching science.	8,36,38,42,49
6-Pos.	There are certain processes in science which children should know, i.e., children should know how to do certain things.	3,15,25,32,53

Scale	Attitudes Assessed by "What is Your Attitude Toward Science and Science Teaching"?	Items Used to Assess Each Attitue
6-Neg.	There are certain facts in science that children should know.	1,19,40,61,68
7-Pos.	Science teaching should be guiding or facilitating of learning. The teacher becomes a resourse person.	6,12,29,55,65
7-Neg.	Science teaching should be a matter of telling children what they are to learn.	10,23,43,46,48

The Science Teaching Attitude Scales will be scored using the attached form and the following procedures:

1. Enter the preservice teacher's response (1, 2, 3, or 4) in the first space to the right of the item number.
2. Enter a value for each response in the second space to the right of the item number according to the following:
   A. For the "Pos." scales,
      if the response is a 1, enter a 3.
      if the response is a 2, enter a 2.
      if the response is a 3, enter a 1.
      if the response is a 4, enter a 0.
      if the response is unanswered, enter a 1.5.
   B. For the "Neg." scales,
      if the response is a 1, enter a 0.
      if the response is a 2, enter a 1.
      if the response is a 3, enter a 2.
      if the response is a 4, enter a 3.
      if the response is unanswered, enter a 1.5.
3. Find the sum of the values for the five responses for each scale.
4. Find the total score by summing the scores for the fourteen scales.

The Science Teaching Attitude Scales

Scoring Attached Form

1Pos.			5Pos.			1Neg.			5Neg.		
16	_____	_____	21	_____	_____	5	_____	_____	8	_____	_____
18	_____	_____	30	_____	_____	41	_____	_____	36	_____	_____
51	_____	_____	34	_____	_____	45	_____	_____	38	_____	_____
56	_____	_____	54	_____	_____	47	_____	_____	42	_____	_____
69	_____	_____	58	_____	_____	63	_____	_____	49	_____	_____
		_____			_____			_____			_____

2Pos.			6Pos.			2Neg.			6Neg.		
11	_____	_____	3	_____	_____	13	_____	_____	1	_____	_____
26	_____	_____	15	_____	_____	60	_____	_____	19	_____	_____
44	_____	_____	25	_____	_____	62	_____	_____	40	_____	_____
64	_____	_____	32	_____	_____	66	_____	_____	61	_____	_____
70	_____	_____	53	_____	_____	67	_____	_____	68	_____	_____
		_____			_____			_____			_____

3Pos.			7Pos.			3Neg.			7Neg.		
9	_____	_____	6	_____	_____	17	_____	_____	10	_____	_____
27	_____	_____	12	_____	_____	33	_____	_____	23	_____	_____
28	_____	_____	29	_____	_____	50	_____	_____	43	_____	_____
31	_____	_____	55	_____	_____	52	_____	_____	46	_____	_____
35	_____	_____	65	_____	_____	57	_____	_____	48	_____	_____
		_____			_____			_____			_____

4Pos.			4Neg.		
14	_____	_____	2	_____	_____
22	_____	_____	4	_____	_____
37	_____	_____	7	_____	_____
39	_____	_____	20	_____	_____
59	_____	_____	24	_____	_____
		_____			_____

APPENDIX G

LETTERS REQUESTING PERMISSION TO CONDUCT THE RESEARCH INVOLVING TEACHER TRAINING COLLEGES IN THAILAND, WITH TRANSLATION

November 19, 1980

Director of Department of Teacher Training
Ministry of Education
Bankok, Thailand

Dear Sir:

I am studying for the Ed.D. Degree in Curriculum and Instruction at Oklahoma State University. I would like to conduct a research involving teacher training colleges in Thailand. This study will be conducted under the supervision of Dr. Ted Mills, my academic adviser and thesis chairman, and with the assistance of the teacher training faculty.

May I please receive your permission to conduct this research in the teacher training colleges? I would appreciate your approval of my request, because it is absolutely necessary for the success of my research. I am looking forward to receiving your favorable response.

Thank you in advance for your time and kind consideration of this matter.

Yours respectfully,

Khatiya Guntawong

Enc. Thesis Proposal

ที่ ศธ. ๐๔๐๗/ กรมการฝึกหัดครู

020757 8 ธันวาคม ๒๕๒๓

เรื่อง ขออนุญาตทำวิทยานิพนธ์

เรียน นางสาวรัตติยา กัณหวงศ์

อ้างถึง จดหมายถึง อธิบดีกรมการฝึกหัดครู ลงวันที่ ๑๔ พฤศจิกายน ๒๕๒๓

ตามหนังสือที่อ้างถึง ท่านได้แจ้งให้ทราบว่ากำลังจัดเตรียมทำวิทยานิพนธ์ เรื่อง "An Investigation of Thai Preservice Teachers' Attitude Toward Science and Science Teaching" และให้กรมการฝึกหัดครูพิจารณาอนุญาตให้ทำวิทยานิพนธ์ในหัวข้อดังกล่าว โดยจะทำการสำรวจทัศนคติของนักศึกษา ระดับ ป.กศ.ชั้นสูง ในวิทยาลัยครูต่างๆ รวม ๘ แห่ง ดังความละเอียดแจ้งแล้วนั้น

กรมการฝึกหัดครูได้พิจารณาข้อเสนอวิทยานิพนธ์แล้ว เห็นว่าจะเป็นประโยชน์ต่อการฝึกหัดครู จึงอนุญาตให้ทำวิทยานิพนธ์ในหัวข้อดังกล่าวได้

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

พ.ส.ม.

(นายพะนอม แก้วกำเนิด)

อธิบดีกรมการฝึกหัดครู

หน่วยศึกษานิเทศก์

โทร. ๒๘๑๖๕๑

November 18, 1980

Ms. Khatiya Guntawong
111 Drummond Hall
Stillwater OK 74077
U.S.A.

Dear Ms. Guntawong:

Your request for permission to conduct the research entitled "An Investigation of Thai Preservice Teachers' Attitudes Toward Science and Science Teaching" in eight teacher training colleges has been received in the Department of Teacher Training.

I am pleased to report that your request was granted. You may now conduct this research in teacher training colleges.

Sincerely yours,

Panom Keawkamnerd
Director of Department of
Teacher Training

APPENDIX H

LETTER REQUESTING PERMISSION TO USE THE INSTRUMENT

June 25, 1980

Dr. Richard W. Moore
Teacher Education Department
Miami University
Oxford, Ohio 45056

Dear Sir:

My doctoral thesis is in the area of measuring the attitudes of preservice teachers toward science and science teaching. It is entitled "An Investigation of Attitudes of Thai Preservice Teachers Toward Science and Science Teaching." I have planned to use the "Science Teaching Attitude Scales" you have developed.

May I please receive your permission to use this instrument for my thesis purpose?

Sincerely yours,

Khatiya Guntawong

Dr. Ted Mills, Professor of
Science Education, Thesis Chairman
Oklahoma State University
Stillwater, Oklahoma 74078

APPENDIX I

ATTITUDES TOWARD SCIENCE AND SCIENCE TEACHING:

RESPONSES OF PARTICIPANTS

ATTITUDES TOWARD SCIENCE AND SCIENCE TEACHING
RESPONSES OF PARTICIPANTS

Central Geographic Cultural Pattern

Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response	Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response
1	67	55	52	69	53
2	70	52	53	78	47
3	71	48	54	77	55
4	72	51	55	69	51
5	63	53	56	73	47
6	66	49	57	71	48
7	70	48	58	57	50
8	67	56	59	80	56
9	67	60	60	70	51
10	78	58	61	68	45
11	69	55	62	61	42
12	58	54.5	63	70	55
13	62	60	64	68	53
14	68	61	65	68	50
15	68	46	66	71	44
16	61	41	67	76	61
17	79	52	68	73	58
18	75	60	69	68	55
19	76	55	70	68	48
20	75	58	71	69	57
21	73	56	72	72	46
22	72	46	73	63	46
23	72	57	74	62	56
24	74	53	75	73	57
25	75	53	76	68	52
26	73	49	77	64	48
27	67	51	78	66.5	51
28	73	36	79	63	48
29	74	58	80	70	52
30	72	56	81	69	49
31	61.5	42	82	77	65
32	62	51	83	60.5	51
33	78	51	84	66	54
34	73	58	85	70	60
35	74	54	86	78	58.5
36	69	47	87	71	54
37	78	61	88	78	51
38	75	65	89	70	59
39	66.5	46	90	61	48
40	69	53	91	65	60
41	75	58	92	65	51
42	69	52	93	72	58

Central Geographic Cultural Pattern (Continued)

Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response	Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response
43	79	49	94	64.5	58
44	82	62	95	73	59
45	68	53	96	73	47
46	69	63	97	72	57
47	74	54	98	70	57
48	68	60	99	68	55
49	67	49	100	70	51
50	83	66	101	64	53.5
51	64	57	102	71	61

Northern Geographic Cultural Pattern

1	75	48	72	70	45
2	74	61	73	77	51
3	67	52	74	70	53
4	60	42	75	74	53
5	66	52	76	67	56
6	75	58	77	70	53
7	65	53	78	78	50
8	64	49	79	81	54.5
9	72	60	80	72	53
10	68	53	81	63	43
11	70	59	82	76	44
12	75	49	73	74	50
13	55	45	84	69	57
14	66.5	45	85	76	61
15	68	56	86	76	59
16	72	56	87	70	47
17	67	49.5	88	75	53
18	74	62	89	64	46
19	63	53	90	64	50
20	65.5	49	91	65	69.5
21	72	49	92	67	42
22	65	53	93	75	49
23	69	52	94	74	54
24	66	53	95	73	51
25	64	50	96	79	51
26	63	51	97	78	68
27	70	55	98	73	59
28	74	53	99	70	52
29	70	53	100	74	43

Northern Geographic Cultural Pattern (Continued)

Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response	Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response
30	71	54	101	76	60
31	68	44	102	73	59
31	78	58	103	68	58
33	68	51	104	72	56
34	70	50	105	74	52
35	61	51	106	67	46
36	64	48	107	71	44
37	66.5	55.5	108	67	57
38	75	55	109	83	60
39	67	49	110	73	51
40	70	55	111	68	55
41	73.5	61	112	77	67
42	70	54	113	75	69
43	77	46	114	70	60
44	84	71	115	83	63
45	78	53	116	73	56
46	69	53	117	69	60
47	71	55	118	72	64.5
48	64	53	119	72	59
49	69	64	120	76	64
50	73.5	57	121	65	58
51	71	53	122	71	62
52	74	62	123	67	67
53	62	64	124	80	59
54	75	50	125	67	54
55	67	52	126	60	54
56	66	63	127	69	59
57	67	52	128	65	58
58	73	50	129	73	55
59	81	44	130	72	52
60	67	52	131	72	60
61	68	60	132	62	48
62	72	62	133	75	59
63	69	59	134	74	54
64	75	46	134	71	55
65	71	51	136	70	53
66	79	57	137	73	60
67	67	42	138	76	57
68	78	61	139	62	46
69	75	44	140	68	54
70	71	52	141	74	54
71	75	67	142	77	58

Southern Geographic Cultural Pattern					
Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response	Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response
1	77	57	40	69	57
2	64	47	41	59	47
3	63	55	42	62	46
4	69	57	43	64	49
5	70	57	44	69	51
6	71	51	45	73	57
7	76	56	46	66	52
8	71	61	47	67	50
9	65	63	48	73	53
10	64	56	49	63	52
11	48	57	50	66	57
12	74	59	51	72	62
13	75	57	52	72	61
14	69	50	53	45	55
15	74	53	54	68	50
16	80	58	55	72	58
17	69	58	56	72	60
18	69	51	57	62	56.5
19	67	57	58	84	43
20	75	50	59	70	54.5
21	72	50	60	58	46
22	70	60	61	61	51
23	68	59	62	65	52
24	78	42	63	59.5	45
25	72	50	64	69	45
26	65.5	52	65	71	50
27	60.5	40	66	67	50
28	67	55	67	68	54
29	63	41	68	76	60
30	57.5	44	69	65	49
31	63.5	50	70	86	57
32	68	49	71	74	58
33	66	43	72	64	59.5
34	75	65	73	78	56
35	66.5	51.5	74	68	56
36	80	55	75	70	59
37	71	49	76	78	58.5
38	74	52	77	79.5	59
39	79	54	78	77	50.5

Northeastern Geographic Cultural Pattern

Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response	Subject	Attitude Toward Science Response	Attitude Toward Science Teaching Response
1	78.5	59	32	75	58
2	67	50	33	82	52
3	72	51	34	79	61
4	77	56	35	65	42
5	67	55	36	70	46
6	68	53	37	80	53
7	65	52	38	71	51
8	89	54	39	77	58
9	75	62	40	61	43
10	71	56	41	57	44
11	74	53	42	59	45
12	82	62	43	76	54
13	67	58	44	78	56
14	68	59	45	73.5	54
15	65	64	46	67	45.5
16	80	57	47	67	56
17	67	70	48	68	45
18	78	55	49	74	49
19	95	67	50	73	36
20	75	56	51	64	45
21	74	57	52	78	56
22	83	62	53	77	55
23	63	63	54	68	50
24	66	55	Total 376		
25	75	53			
26	83	61			
27	74	57			
28	69	49			
29	79	60			
30	64	45			
31	80	61			

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