DOCUMENT RESUME

ED 340 613 SE 052 654

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TITLE	An Inter-Cultural Comparative Study on Elementary Science Teachers' Perceptions of Their Behavior and Inservice Needs between Japan and North Carolina.
PUB DATE	Nov 91
NOTE	152p.; M.A. Thesis, East Carolina University.
PUB TYPE	Dissertations/Theses - Masters Theses (042) -- Tests/Evaluation Instruments (160)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Classroom Environment; Cultural Differences; Elementary Education; Elementary School Science; Foreign Countries; *Inservice Teacher Education; *Needs Assessment; *Preservice Teacher Education; Professional Development; Questionnaires; *Science Education; Teacher Attitudes; *Teacher Qualifications; Teaching Experience; Teaching Methods
IDENTIFIERS	*Japan; *North Carolina

ABSTRACT

This study compared several facets of teacher education between Japan and North Carolina. Similarities and differences in elementary science teachers' perceptions of the academic backgrounds in Japan and North Carolina were evaluated as well as similarities and differences in elementary teachers' perceptions of classroom practices in Japan and North Carolina using a questionnaire consisting of five parts: (1) academic background; (2) inservice education opportunity; (3) autonomy; (4) teaching objectives; and (5) teaching methods. Four hundred and ninety Japanese and 181 American elementary teachers were asked to rate their perception of the frequency of experience and the degree of value they placed on each questionnaire item. Frequent behaviors of teachers were observed by identifying the items with higher mean scores rated by elementary teachers who teach science. Items with high value and low frequency were identified as teachers' needs. Items with high value and high frequency were identified as teachers' strengths. Confidence of teachers in each sample were the items listed as strengths by many teachers. As a result of the surveys in Japan and North Carolina, it was revealed that teacher performance in classrooms is not so different. However, there were some differences found in their academic backgrounds, opportunities for inservice training, and teachers' autonomy for acquiring knowledge and skills. Elementary teachers in North Carolina were more confident in having a broader view of education compared to Japanese elementary teachers. It might be necessary for Japanese teachers, science educators and researchers to learn more about pedagogical courses in teacher preservice programs in the United States. Teachers in North Carolina perceived a need for academic and professional activities as contrasted with Japanese teachers who perceived a need for activities closely related to their class and classroom environment. Copies of the draft questionnaire and the questionnaire used in North Carolina are appended. (Author/KR)

ED340613

AN INTER-CULTURAL COMPARATIVE STUDY ON ELEMENTARY SCIENCE TEACHERS' PERCEPTIONS OF THE.R BEHAVIOR AND INSERVICE NEEDS BETWEEN JAPAN AND NORTH CAROLINA

A Thesis

Presented to

the Faculty of the Department of Science Education

East Carolina University

In Partial Fulfillment

of the Requirements for the

Master of Arts in Education

by

Kinya Shimizu

November 1991

SE052654

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Acknowledgements

I would express special appreciation to **Dr. Claudia Melear** at East Carolina University for academic advice and suggestion during my working on this thesis I also wish to express my gratitude to other faculty members in the School of Education of East Carolina University **Dr. Charles Coble, Dr. Donald Spence, Dr. Patricia Anderson, Dr. Robert Brown, Dr. Joseph Ciechalski,** and **Dr. Donald Bragaw** **Ms. Buddaz** principal of Wahl Caotes School and **Mr. George Stancil** Superintendent of Bertie County **and my classmates in SCIE 6200 at East Carolina University** for accepting my request for delivering questionnaires

I would also like to extend my special appreciation to the members of my thesis committees **Dr. Charles Coble, Dr. Floyd E. Mattheis, and Dr. Scott Watson**

Kinya Shimizu. AN INTER-CULTURAL COMPARATIVE STUDY ON ELEMENTARY SCIENCE TEACHERS' PERCEPTIONS OF THEIR BEHAVIOR AND INSERVICE NEEDS BETWEEN JAPAN AND NORTH CAROLINA (Under the direction of Dr. Claudia T. Melear) Department of Science Education, November 1991.

Many reports on education, such as A Nation at Risk, A Nation Prepared, and Tomorrow's Teachers, were published in the early 1980's. Teacher education is one of the areas to which American educators are currently devoting attention. In Japan, teacher competency has become one of the most important issues as well. The purpose of this study was to compare several facets of teacher education between Japan and North Carolina. Similarities and differences in elementary science teachers' perceptions of the academic backgrounds in Japan and North Carolina were evaluated as well as similarities and differences in elementary teachers' perceptions of classroom practices in Japan and North Carolina.

The questionnaire consisted of five parts: academic background, inservice education opportunity, autonomy, teaching objectives, and teaching methods. Four hundred and ninety (490) Japanese and 181 American elementary teachers were asked to rate their perception of the frequency of experience and the degree of value they placed on each questionnaire item. Frequent behaviors of teachers were observed by identifying the items with higher mean scores rated by elementary teachers who teach science. Items with high value and low frequency were identified as teachers' needs. Items with high value and high frequency were identified as teachers' strengths. Confidence of teachers in each sample were the items listed as strengths by many teachers.

As a result of the surveys in Japan and North Carolina, it was revealed that teacher performance in classrooms is not so different. However, there were some

differences found in their academic backgrounds, opportunities for inservice training, and teachers' autonomy for acquiring knowledge and skills. Elementary teachers in North Carolina were more confident in having a broader view of education compared to Japanese elementary teachers. It might be necessary for Japanese teachers, science educators and researchers to learn more about pedagogical courses in teacher preservice programs in the United States. Teachers in North Carolina perceived a need for academic and professional activities as contrasted with Japanese teachers who perceived a need for activities closely related to their class and classroom environment.

TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

Chapter 1
Introduction

Statement of the problem

Teacher professionalism

Educators in Japan and in the United States have been striving to reform teacher education during the 1980's and 1990's. One motivating force for this movement is that teachers must be the key to solve educational problems which nations are facing, and that the teachers must be considered professionals. A Nation Prepared noted:

> We can not hope to bring the mass of our citizens up to the standards we have proposed unless such people are available in large numbers to teach our children. Textbooks can not do it. Directive from state can not do it. Only the people with whom the student come in contact every day can do it.
>
> (Carnegie Forum on Education and Economy, 1986: p.26)

From the perspective that the minds of citizens are major resources of the country, Dr. Bonnie J. Brunkhorst, the National Science Teachers Association (NSTA) 1990-1991 President, noted:

> Our nations' standard of living will decline if we don't change our current practice. As with any investment, however, it makes no sense to waste any of our resources. The more we waste, the higher the eventual costs. We must therefore use teachers minds to the fullest. The science teachers who teach the children are key to improving the scientific literacy of our people.
>
> (Brunkhorst, 1990: p.3)

In Japan, in order to resolve the issues which Japanese society is facing, such as school violence, tight student management, teacher discipline, bullying among the students, and drastic changes of society into internationalization, teachers are being expected to be the specialists or professionals dealing with all of these issues. Yoshida introduced objectives of reform of Japanese teacher education, as follows;

> All teacher training shall aim to conduct scholarly and creative research to produce teachers capable of carrying out the following basic concept of education:
>
> 1. instill respect for children's individuality.
> 2. put emphasis on the basis of education,
> 3. enhance children's creativity, thinking, and expressive abilities,
> 4. create a humanized educational environment for children
> 5. promote lifetime education through a pragmatic way of teaching and learning.
> 6. cope with internationalization and advances of information technology,
> 7. have an innate desire to grow professionally by further studying graduate courses, attending inservice training programs reading professional magazines and related literature.
>
> (Yoshida, A. 1986: p.1)

In brief, Yoshida indicated that the reform of Japanese teacher education must shift to develop teacher professionalism in order to prepare citizens for future society. Under the recognition of the teacher as a key, current efforts of the educational reforms in both countries are devoted to teacher education.

<u>The reform of preservice teacher education</u>

There are differences in the level of competence desired in the United States and Japan. Each recommendation in the United States emphasized teachers knowledge and skills in science and science teaching methods. On the other hand, Japanese reform focused on pedagogical knowledge and understanding of children. For example, in Japan the number of required pedagogical courses was raised by the revised <u>Educational Personnel Certification Law,</u> but the number of science content courses such as physics, chemistry, biology and earth science for prospective teachers has not been changed. In the United States, the National Science Teachers Association (NSTA) Standards for Preparation of Middle/Junior High School Teachers of Science recommended 48 semester hours of science courses for prospective junior high school teachers and 36 semester hours of science content courses for middle school teachers. However, more than sixty-percent of preservice institutions for secondary teachers require their students to take less than 40 semester hours of science content courses (Peterson, 1990).

Raising standards for licensing is one of the trends in the teacher education reform movement both in Japan and in the United States. However, it is indicated that preservice education has some limitations in improving teacher competencies. One of the critical issues in Japan is unification of theory and practice. Student teaching is considered to be a good opportunity for improvement. However, some problematic situations in student teaching exist in Japan. Included are the difficulty in finding cooperative schools, and relatively short terms of student teaching. Nakajima (1988) states that student teaching does not always work effectively. In addition, in terms of science specialization knowledge of elementary teachers, Nakajima (1988) found imbalance of science courses among elementary education major concentrating in science and elementary education majors not concentrating in science. Elementary science majors are likely to take excessive amount of science courses in order to also acquire the secondary science teacher license. Non-science education majors in preservice institution for elementary teachers tend to put less emphasis on science content or methods courses. Nakayama (1990) commented that these imbalances need to be taken into account not only during preservice training, but also during inservice training.

With regard to limitations of preservice programs in the United States, Padilla (1990) describes the problem in the licensing process. Padilla indicates that while professional associations such as NSTA, the National Association of Biology Teachers (NABT) and the National Council for Accreditation of Teacher Education (NCATE) recommend solid standards for accrediting, each state sets up only minimum standards for the sake of their responsibility to fill all science classrooms. The report of the 1985-86 National Survey of Science and Mathematics Education by Research Triangle Institute (Weiss, 1987) indicates that most teachers at each school level do not meet NSTA standards in terms of both science courses and science teaching methods courses. In order to improve teacher quality, both preservice education and inservice teacher education programs must be improved both in the United States and in Japan.

Examining the quality and needs of teachers might be one of the best ways to enhance the quality of inservice training and teachers. In addition, since science is a universal subject, describing teacher performance through international perspectives is considered to be an effective way to pursue these co-incidental issues.

Purpose of the Study

The purposes of this study are;

(1) to identify similarities and differences in elementary science teacher perceptions of their academic background in Japan and North Carolina.

(2) to identify similarities and differences in elementary science teacher perceptions of classroom practices in Japan and North Carolina.

Research Questions

To complete the purpose of this study the following research questions are included:

(1) What are the identifiable differences, if any, in the self-reported academic backgrounds of elementary science teachers in Japan and North Carolina?

(2) What are the identifiable differences, if any, in the self-reported teachers' inservice opportunities of elementary science teachers in Japan and North Carolina?

(3) What are the identifiable differences, if any, in the self-reported teachers' autonomy for acquiring the knowledge and skills in teaching of elementary science teachers in Japan and North Carolina?

(4) What are the identifiable differences, if any, in the teachers self-reported teaching objectives for their science lessons in Japan and North Carolina.

(5) What are the identifiable differences, if any, in the self-reported science teaching methods utilized by elementary teachers in Japan and North Carolina.

In this study, the research questions noted above are discussed by describing teachers' frequent behavior, teachers' confidence, and teachers' needs they perceive.

Definitions

For the purpose of this study, the following terms are defined :

Experience represent teachers' perceptions of frequency of which teachers applied objectives, activities, and behaviors to the classroom setting.

Value represent the degree to which teachers valued objectives, activities, and behaviors on each items in the questionnaires.

Frequent behaviors represent the items with higher mean score on experience scales by each sample.

Strength represents the item rated highly both in the experience scale and in the value scale on the questionnaires.

Confidences represent the items with high percentage of teachers perceiving the strength.

Needs represents the item rated low frequency in experience scale and high in value scale on the questionnaires.

In Japan, all **Elementary Schools** have grades 1-6 for the children aged 6-11. Therefore, in this study, Japanese elementary schools are automatically defined as school for 1-6, and Japanese elementary teachers are automatically defined as teachers of grades 1-6.

National Association of Directors and Principals for Elementary Science Education is a Japanese organization for elementary school principals who are interested in elementary science education.

Educational Personnel Certification Law (Kyouiku shokuin menkyo ho) is the Japanese law which regulates the system of licensing and certifying educational personnel including school teachers, assistant principals and principals. In 1989, this law was revised.

Chapter 2

Review of the Literature

The review of the literature will consist of sections:

a) General Concerns of Inservice Training;

b) Specific Concerns of Inservice Training;

c) American Literature of Expected Teacher Qualities; and

d) Japanese Literature of Expected Teachers Qualities;

During the past decade, the interest of science educators in inservice programs increased. According to Spector and Spooner (1989), science and mathematics education has been the explicit target for much of the monies that have become available for inservice in the past six years. Recent articles related to inservice teacher training can be divided into: 1) general concerns which might influence any type of inservice activities, 2) specific concerns for specific inservice activities, and 3) expected qualities of science teachers in the United States and Japan.

General Concerns of Inservice Training

Yeany and Padilla (1986), through a meta-analysis of teacher education research, identified five types of teacher training programs whose purpose were to analyze and evaluate teaching behavior as follows:

1) study of analysis systems,
2) observing models,
3) analyzing models,

4) self analysis, and
5) peer or instructor feedback.

(Yeany, R. H. and Padilla, M.J., 1986: pp 89-90)

Nash (1985) developed a graphic model of a teacher center designed to meet the needs of science teachers. The author's conclusions are as follows:

a) A teacher center designed to meet the needs of science teachers should focus on the teaching related concerns of science teachers.
b) Middle and high school science teachers' and professional inservice educators' perceptions of a teacher center compared favorably with the proposed graphic model.
c) The teacher centers studied were not of the comprehensive level favored in the model.
d) The graphic model had as a central focus, whatever they might be the teaching related concerns of science teachers.

(Nash, M.C., 1985: 667A)

Through a survey of K-6 teachers across the United States (n-252), Teters, Gabel, and Geary (1984) determined the status of science teaching in elementary schools and indicated what could be done to improve education. Findings indicated that life science was taught more than physical science and earth science, that the hands-on approach is used less in the upper grades, and that most instruction in large size classes are instructor dominated in any grade level.

Johns (1984) identified teaching obstacles, through the surveys of Nevada elementary school teachers (n-272), to rank order twelve obstacles to teaching science. The greatest obstacles were lack of inservice facilities, lack of supplies and equipment (or funds to purchase them), and inadequate room facilities.

Duschl (1984) determined, using ethnographic methods, the degree to which teachers make decisions based on scientific theories. The following findings were reported:

> (1) Science teachers give little consideration to scientific theories in their instructional task decision making
> (2) Instructional task decisions are dominated by
> (a) teaching propositional knowledge;
> (b) using selected scientific processes as vehicles for teaching propositional knowledge;
> (c) teaching the objectives outlined in curriculum guides;
> (d) coping with pressures of accountability; and
> (e) humanistic ownership feeling toward the student.
>
> (Duschl, 1984: 482A)

Aikenhead (1984) explored results from a case study of five high school teachers about the ways teachers make decisions when they plan for instruction. Decisions made by teachers in the study had common structures which involved "tradeoff" and "compromises" (Aikenhead, 1984: p.183). The decision represented the end result of the conflict between a cluster of teacher intentions and a melange (mixture) of ideas about student characteristics (Aikenhead, 1984: p.184).

Specific Concerns of Inservice Training

The research focusing on topics of inservice programs can be divided into four types.

1. Student learning

Lombart, Konicek, and Schultz (1985) assessed an inservice program intended to promote student reasoning using the learning cycle. It concluded that it is important to collaborate with colleagues in utilizing peer coaching in initiating and in maintaining a teaching innovation.

2. Curriculum

Mckinnon (1984) investigated the relationship among Science Curriculum Improvement Study (SCIS), teacher attitudes toward science and science teaching, grade level of teaching, and their spatial ability (n-76). Findings indicated that:

(1) There is a statistically significant relationship (.05) between spatial ability and attitude toward science and science teaching.
(2) There is a statistically significant relationship (.05) between spatial ability of SCIS teachers and the grade level at which they teach.
(3) There is a statistically significant relationship between the spatial ability of a SCIS teacher and their years of experience with the SCIS program.

(McKinnon, G. R., 1984: 1359A)

Loucks (1984) investigated the concerns of SCIS elementary school teachers who were attending workshops in 1974 (n-45) and 1975 (n-38) for implementing the SCIS curriculum using the Stage of Concern

Questionnaire (SoCQ) SoCQ is a Likert type measurement tool assessing seven hypothesized stages of concern which are (1) awareness, (2) informational, (3) personal, (4) management, (5) consequence, (6) collaboration, and (7) refocusing. Results indicated that the stage of concern of individuals has been recognized as developmental.

Bonnstetter and Kyle (1986) found that there were no significant differences in the perception of science between teachers' trained in SCIS and those not trained in SCIS. However, attitudes of students (n-684) taught by SCIS teachers were improved significantly when compared to students taught by non-SCIS teachers (n-447).

Chakagondua (1984) examined congruencies and discrepancies between program developers' and elementary teachers' perception of new elementary science programs. Most of the responses from both groups showed similar viewpoints of new programs.

Lombana (1984) identified both encouraging and discouraging factors to the implementation of innovative elementary hands-on science. The authors identified five encouraging factors as follows: (1) workshop experience before implementation,

(2) flap-top desks,
(3) sinks located in rooms,
(4) complete set of materials,
(5) producers for keeping kits.

(Lombana, J. D., 1984: 157A)

Five discouraging factors were identified as follows:

(1) lack of materials,
(2) sharing kits between more than two teachers,
(3) completion for instructional time from reading and math,
(4) slant top desks,
(5) preparation time involved for each lesson.

(Lombana, J.D., 1984: 157A)

Orlich (1984) identified effective qualities of elementary science inservice activities through reviewing the studies of inservice programs. The author describes the characteristics of effective qualities of elementary science inservice activities as follows:

(1) Effective inservice programs have specific focus or set of objectives.
(2) Effective programs use curricula that can serve as exemplars.
(3) They provide hands-on experiences and allow teachers to use concrete teaching material.
(4) Laboratories, field trips, visits to museums, and opportunities to share experience are part of the most effective programs.
(5) Effective inservice projects result from the ability of university faculty to adapt themselves to what is needed. Teachers do not automatically offer the usual courses.
(6) All effective inservice projects are relevant to the jobs of the participants and the conditions in which the participants actually work.
(7) A good program teaches participants how to use the knowledge they've gained, not simply how to gain it.
(8) The most effective inservice programs are apparently part of continuous programs, rather than just one-shot activities.

(Orlich, D.C., 1984: p.34)

3. Strategies of Inservice Programs

Several studies focused on strategies of inservice training. These could be divided into 4 groups. They are (1) psychological factors, (2) workshops, and (3) role of master teachers.

(1). Psychological factors

In this category, each author focused on interaction between participants and instructors in inservice programs.

Conwell (1984) examined the effects on achievement and attitude of the interaction between specific types of learners by using the Myers-Briggs Type Indicator. According to the result of this study, 56 out of 96 elementary teachers were SF (Sensing-Feeling). The activities well matched to SF qualities received more positive ratings by SF teachers than non-SF teachers.

(2). Workshops

Spector and Spooner (1989) reported that workshops are the most popular type of inservice activity. The studies related to workshop strategies could be seen most frequently in this literature review.

Stone (1987) examined the effect of follow-up type staff development programs on classroom teachers (n-67) including (1) attending a local science teacher conference, (2) reading monthly newsletters, (3) participating in team meetings each month, and (4) experts observation. It is revealed that there are significantly positive effects of combinations of these developmental programs on confidence in and commitment to teaching science.

McFarlane (1984) determined the effect of a developed science unit and regular consultant contacts on the attitude of elementary teachers (n-23) toward science and the teaching of science. There were no significant treatment effects found in this study. However, analysis of gain scores indicated significant relationships exist in between teacher attitude toward science teaching and grade taught, building assignment, and the teacher's age.

(3). Role of master teachers

Spector (1985) assessed graduate training needs of science teachers in southern Florida by qualitative research methods in order to determine the desired status of master's degree. The author recommended as follows:

> The results suggested that the contents of a desired state master's degree should be based on a task analysis of what teachers are expected to do in meeting the needs of their students in the 1980s' and beyond.
>
> (Spector, B.S., 1985: p.344)

Lawrenz (1987) evaluated the inservice training in physical science offered by master teachers. Twenty master teachers out of 41 applicants who attended a summer institute offered the inservice training to 330 teachers in local district. Effectiveness of master teachers in summer institutes were revealed by this study.

Inservice training must be relevant to teachers' needs and their competencies and qualities. In terms of the qualities and characteristics of teachers, the following studies have been completed.

American Literature of Expected Qualities for Teachers

Gallagher and Tobin (1987) investigated the activities and interactions of 15 teachers and their students in two Western Australian high schools. This ethnographic study examined activity structures, reward systems, teachers expectations, and disruptive students. It also examined contrasting managerial styles of three teachers. The authors derived several assertions as follows:

(1) Secondary science teachers equate task completion (coverage of content) with student learning.
(2) A majority of class times is devoted to whole-class interaction during which the pace of instruction depends on the responses of 5-7 more able students whom we called target student.
(3) Teachers held different expectations of their students during the class work and laboratory work.
(4) The level of cognitive demand placed on student during science classes and labs tended to be relatively low.
(5) Students with poor achievement and motivation frequently were problematic to secondary science teachers who offered watered-down versions of regular classes to them.
(6) Some disruptive behavior occurred in all classes - in most cases disruptions were minor. Disruptive behavior often appeared to occur when the cognitive demand of tasks exceeded the capabilities of students to respond.

(7) Preparation for examinations (both teacher developed and external examination) was continually reinforced by teachers as the purpose of insiruction, class work, homework, and laboratory work.

(Gallagher, J.J. and Tobin, K., 1987: pp.552-553)

Rubba and Becker (1985) surveyed 228 Illinois principals to determine the qualities they examine when hiring mathematics and science teachers. Content area knowledge, area of certification, and personality characteristics were of higher priority than sponsoring extra-curricular activities, references, and minor areas of certification.

Donaldson (1985) investigated the extent of agreement between selected college level elementary science educators (n-107) and fourth, fifth, and sixth grade Kansas science teachers (n-25o) regarding the science laboratory teaching competencies that should be possessed by teachers. Each group was given a questionnaire focused on operational, process, management, developmental, and evaluation items. The results are as follows:

(1) Science teachers believe there is a somewhat greater need for competencies related to microscope use, cleaning glassware, and use of models.
(2) Science educators perceive a somewhat greater need (than teachers) for cultures in the classroom and for use of keys (in identification) such as terraria and aquaria, use of metric system, use of histograms, and use of electric circuits.
(3) Teacher educators regarded all science process competencies at a higher need level than did science teachers.
(4) The four items within the process competencies did not yield significant differences between the two group.

(5) Of the four items within the area of developmental competencies, three produced chi square values that were significant below the .05 level. Hands-on approaches, individualized learning, and low budget or homemade materials were favored more by teacher educators than by teachers.
(6) Teacher educators favored the following items to a greater degree than did teachers: Skill tests and checklist, student feedback instruments, and audio-tape techniques.

(Donaldson, H.C., 1985: 3067A)

Tulloch (1986) identified teachers' competences which are considered to be important to the growth of beginning teachers. The data were collected from 250 science supervisors, 250 science educators, and 500 secondary science teachers. Following competences were identified by factor analysis:

(1) attending to the mechanics of teacher-centered instruction,
(2) showing sensitivity to pupils' feelings and values, and
(3) planning the instructional program

(Tulloch, 1986: p.555)

Bentley (1985) examined the perception of the conditions of good science teaching which secondary science teachers hold (n-94). A 54-item questionnaire developed on the basis of the NSTA publication "Condition of Good Science Teaching in Secondary Schools was utilized. Teachers who participated in this study agreed that most items listed in questionnaire are important to the condition of good science teaching. However, they also perceived these conditions are hard to accomplish.

Mullenx and Smith (1987) described an attempt by universities to assess the needs of 22 rural school district in science and mathematics. As a result of this research, six major needs of rural areas in Virginia were identified.

(1) Content courses for both elementary and secondary teachers in content areas of science and mathematics,
(2) Curriculum development in science and mathematics,
(3) Science activities for primary and elementary student,
(4) Resource guides (for teachers) which describe available instructional television (ITV) programs, computer software, and human resources, to complement the science and mathematics curricula,
(5) Conference for high school students at the university,
(6) Funds to purchase needed equipment and materials.

(Mullenex and Smith, 1987: p. 3)

Japanese Literature of Expected Qualities for Teachers

Inoue (1989) surveyed 455 elementary school (Grade 1-6) principals in Fukuoka Prefecture (equivalent to a state in the United States) in the expected quality of teachers. Factor analysis revealed that competence of teachers expected by school principals were generosity, dignity, strictness, sense of responsibility, adaptability, instructional skills, inquisitiveness, trust, attentiveness, healthiness and self direction skills. With regard to expected personality, the school principal expected teachers to be enthusiastic, lively, and to work hard. The author concluded that: (1) teachers' instructional skills are supported on the basis of their personality; (2) the evaluation of teacher competence is correlated with the evaluation of their personality; and (3) socio-cultural rules should be applied also to teachers' society in school.

Inoue (1986) investigated elementary classroom teachers on the construct of teaching skills, and examined the difference in age and gender, using Likert type questionnaire. It was revealed that teachers perceived high value in terms of questioning, knowledge of teaching content, relationships with children, sequencing the learning content appropriate for children's understanding, grouping children's physical and mental characteristics, understanding of children's thinking and feeling, educational views intending to develop children's ability, sense of responsibility and enthusiasm, and skills for observing children closely. It was reported that older teachers are more likely to implement classroom activities than younger teachers. There were also differences in implementation and values between male teachers and female teachers. The factor analysis identified 13 factors in desirability questions and 14 factors in implementation questions. The author concluded that an expected quality of teachers is to hold a solid educational view, and that the teachers should implement instruction in the classroom on the basis of their own educational view. In terms of science education, Shimada (1988) emphasized the balance of academic knowledge and skills in science and academic knowledge and skills for teaching science.

Chapter 3
Methodology

This chapter includes:

a) Development of Questionnaires

b) Administering the Questionnaires

d) Methods of needs Assessment.

c) Data Processing

In this study, the elementary teachers' perception of their (1) academic backgrounds, (2) opportunity for training , (3) autonomy for acquiring the knowledge and skills in teaching, (4) teaching objectives for their science lessons, and (5) science teaching methods utilized are compared in Japan and United States. In order to address perceptions of teachers' activities, the questionnaire used in this study was the revised teachers self assessment tools which was presented in United States- Japan Cooperative seminar by faculties of the Science Education Department in Hiroshima University.

Development of Questionnaire

The draft of the questionnaire used in this study was developed by the Science Education Department of Hiroshima University in Hiroshima, Japan. This draft questionnaire (Appendix A) consists of 10 elements: (1) Objectives (2) Academic Background (3) Teaching Content (4) Lesson Plan (5) Teaching Methods and Strategies (6) Management of Science Room and

Laboratory (7) Teaching Materials Production (8) Evaluation of Student Learning (9) Teachers' Opportunities for Inservice Training and (10) Teachers' Autonomy in Acquiring Knowledge and Skills in Teaching. The subjects report their perception of frequency of their experience they have had on each item and their perception of the degree of value they have on each item. The items used in this study are selected from the questionnaire developed in Hiroshima University.

In the revised questionnaire, American teachers were asked to rate, in five ranges (5: Very often, 4: Often, 3: Sometimes, 2: Seldom, 1: Never), the frequency of their experience they have had on each item, and to rate, in three ranges (3: High value, 2: Intermediate value, 1: Low value), degree of value they have on each item (Appendix C.). In the Japanese questionnaires, Japanese teachers were asked to rate both frequency of experience (4: Very often, 3: Often, 2: Seldom, 1: Never) and degree of value in four ranges (4: High value, 3: Relatively high value, 2: Relatively low value, 1: Low value).

The difference in scales of the American questionnaire and the Japanese questionnaire came about due to a change in the Japanese version that occurred before it was administered to the Japanese sample. This change was, unfortunately, beyond the researcher's control.

Administering the Questionnaire

In Japan, six hundred questionnaires were mailed to the participants of the Annual Conference of the National Association of Directors and Principals for Elementary Science Education to ask elementary teachers to fill out questionnaires. 490 teachers returned questionnaires to Hiroshima University (return rate 81.7%). In North Carolina, 300 questionnaires were distributed to elementary teachers in North Carolina; 35 participants included teachers in workshop of Developmental Approaches in Science and Health (DASH) and Full Optional School Science (FOSS), 20 sixth grade teachers working for the North Carolina Project of Reform in Science Education, 125 graduate students at East Carolina University who are teaching science in elementary schools, 100 elementary classroom teachers in Bertie County in North Carolina, and 20 Science teachers in Wahl Coates Elementary School (a cooperating school of East Carolina University). One hundred eighty-one responses were received (return rate 60.3%).

Methods of data analysis

In this study, frequent behaviors of teachers in Japan and North Carolina are observed by identifying the items which are perceived with higher mean scores by elementary science teachers in Japan and in North Carolina. The number of items identified with frequent behaviors is determined by the number of all items within each category.

Concerning confidences and needs of teachers, the elementary teachers' perceptional gap between frequency of experience they have had on certain activities and value teachers placed on same activities were considered. Items rated highly in both experience scales and value scales by each teacher can be considered to be the items on which he/she behaved frequently along with their value in terms of each item. Therefore, in analyzing the Japanese data, the items each Japanese teacher rated above 2 both in experience scales and in value scale, are identified with his/her "Strength" (see figure 1). In analyzing the American data, the items rated above 2 in experience scale and above 1 in value scale by each teacher in North Carolina are identified with his/her "Strength" (see figure 2). In this study, teachers' "confidences" in each sample are identified with the items which is perceived as strength by higher percent of teachers in each samples. The number of items identified with teachers' confidence is determined by the number of all items within each category.

The items rated as high value and as low frequency by each teacher can be considered to be the item with which he/she should deal in the future. Therefore, The items each teacher rated below 3 in experience scale and above 2 in value scale are identified with his/her "Needs" (see figure 1). The items teacher rated below 3 in experience scale and above 1 in value scale are identified with his/her "Needs" (see figure 2). In this study, teachers' needs in each sample are observed by identifying the items in which a higher percent of teachers in each samples perceived as needs. The number of items identified with teachers' needs is determined by the number of all items within each category.

Data Processing

SAS at HITAC M-680H in Hiroshima University Information Processing Center was used to analyze the Japanese data with the assistance of Mr. Yasushi Ogura, Research Associate of Department of Science Education in Hiroshima University. In order to analyze the data in North Carolina, SAS @ ECU-VM1 at East Carolina University was used. In order to identify frequent teacher behaviors, PROC MEAN procedure was used, and PROC FREQ procedure was used in identifying teachers confidences (frequent behavior supported by teachers' value) and teachers needs (not frequent behavior but high valued by teacher).

Figure 1 Methods of Needs Assessment in Japan

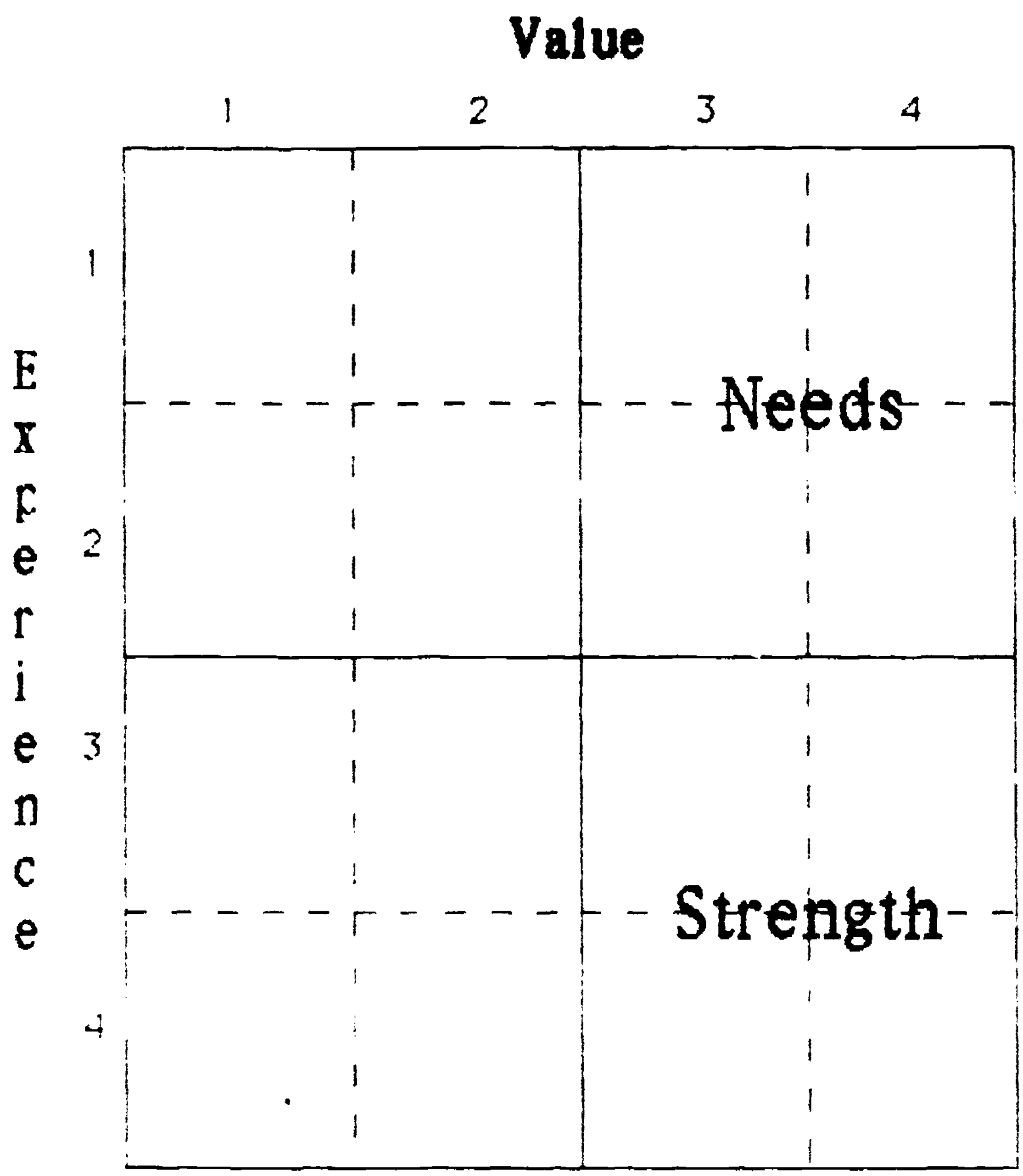
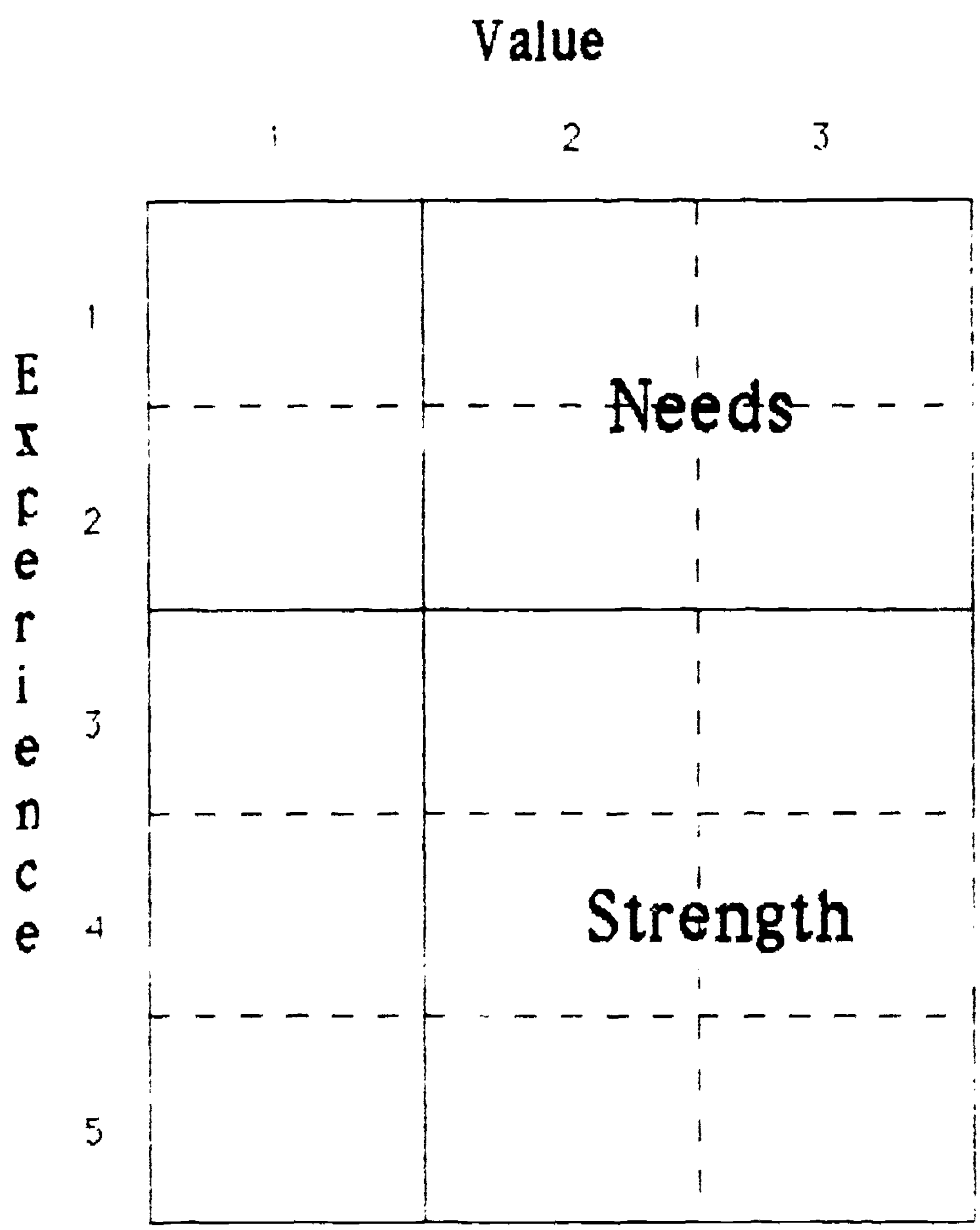


Figure 2 Methods of Needs Assessment in N.C.



Chapter 4: Findings

This chapter includes the results of:

a) The Self-reported Academic Background.

b) The Self-reported Teachers' Opportunities for Training

c) The Self-reported Teachers' Autonomy for Acquiring the Knowledge and Skills in Teaching

d) The Self-reported Teaching Objectives

e) The Self-reported Science Teaching methods

In this chapter, teachers' frequent behaviors, confidence, and needs in Japan and North Carolina are described in terms of their teacher education background, including academic background, opportunity for training, autonomy for acquiring the knowledge and skills for teaching, and classroom practice including teaching objectives and teaching methods.

There is a difference in the scales between the Japanese questionnaire and the American questionnaire. The questionnaire used in North Carolina, asked teachers to rate the degree of experience in 5 ranges (5: Very often, 4: Often, 3: Sometimes, 2: Seldom, 1: Never) and to rate degree of value in 3 ranges (3: High value, 2: Intermediate value, 1: Low value) (Appendix C.). In the Japanese questionnaires, Japanese teachers were asked to rate both the amount of times teachers spent on certain teaching activities (4: Very often, 3: Often, 2: Seldom, 1: Never) and value teachers placed on certain teaching activities in 4 ranges(4: High value, 3: Relatively high value, 2: Relatively low value, 1: Low value) (Appendix B.)

Because of this difference, it is not possible to compare the raw data directly. Therefore, in this study, the similarities and differences will be identified by identifying the items rated high among each item in each element in Japan and North Carolina.

The Self-reported Academic Background

The following items are identified as frequent behaviors in terms of academic background of teachers in Japan and North Carolina, according to the observation of Table 1.

Japan
- I possess sufficient background in the area of science education other than my area of specialization (item 3, mean score 2.47, N=461)).

- I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students (item 7, mean score 2.38, N=472).

- I have sufficient background in mathematics required/applicable to the science courses I teach (item 4, mean score 2.25, N=471).

North Carolina
- I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives (item 9, mean score 4.38, N=173).

- I possess knowledge and understanding of the philosophical, historical and social purpose of education (item 8, mean score 4.28, N=173).

- I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students (item 7, mean score 4.22, N=172).

Table 1

Mean frequency score and mean value score on each item
(1)Academic background

Items	JAPAN*				NORTH CAROLINA*			
	EXPERIENCE	(N)	VALUE	(N)	EXPERIENCE	(N)	VALUE	(N)
1	1.62	(457)	2.41	(463)	2.76	(162)	2.30	(159)
2	1.73	(463)	2.56	(462)	2.86	(167)	2.42	(163)
3	2.47	(461)	3.14	(465)	3.21	(170)	2.50	(171)
4	2.25	(471)	2.85	(467)	4.22	(174)	2.69	(175)
5	1.86	(472)	2.62	(465)	3.20	(173)	2.31	(176)
6	2.05	(472)	2.88	(466)	3.91	(172)	2.55	(175)
7	2.38	(472)	3.26	(468)	4.22	(172)	2.78	(175)
8	2.10	(475)	2.82	(460)	4.28	(173)	2.64	(176)
9	2.22	(472)	3.07	(465)	4.38	(173)	2.74	(175)

Note

* JAPAN 4 - Very often, 1 - Never in experience scale
4 - Most important, 1 - Least important in value scale
* N.C. 5 - Very often, 1 - Never in experience scale
3 - High value, 1 - Low value in value scale

Items

1. I have sufficient pre-service background equivalent to a major (or minor) in each science, biology, chemistry, or physics education.
2. I have acquired in-service trainings that are similar to my pre-service major (or minor) in each science, biology, chemistry, or physics education.
3. I possess sufficient background in the area of science education other than my area of specialization.
4. I have sufficient background in the mathematics required/applicable to the science course I teach.
5. I have studied the historical development and philosophy of science, including the continuing contributions of scientists to modern world.

(Cont Table 1)

6 I possess sufficient background in non science fields such as the humanities, social sciences, languages, and philosophy, to enable me to provide a wider perspective and relevance to my science teaching.

7 I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students

8 I possess knowledge and understanding of the philosophical, historical and social purpose of education

9 I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives.

- I have sufficient background in the mathematics required / applicable to the science courses I teach (item 4, mean score 4.22, N=174).

Academic backgrounds in psychology (item 7) and mathematics (item 4) are identified as frequent behaviors by both samples. In addition, possessing a strong background in science education rather than science content (item 3) is identified as one of the frequent behaviors by the sample in Japan. On the other hand, possessing the strong background in pedagogical knowledge of educational purpose (item 8) is identified as one of the frequent behaviors by the sample in North Carolina.

Concerning teachers' confidence in their academic background, the following items, according to the observation of Table 2, are identified as confidence by teachers in each sample.

Japan

- I have sufficient background in the mathematics required/applicable to the science courses I teach (item 4, 70.3%, N=451).

- I possess sufficient background in area of science education other than my area of specialization (item 3, 46.6%, N=438).

- I possess sufficient background in psychology to enable me to understanding the physical, emotional, and intellectual development my students (item 7, 39.9%, N=451).

North Carolina
- I possess both background and enrichment in curriculum development technique such as content sequencing, concept development, and writing of instructional objectives (item 9, 97.1%, N=171).

- I possess knowledge and understanding of philosophical, historical and social purposes of education (item 8, 95.9%, N=171).

- I possess sufficient background in psychology to enable me to understand the physical, emotional and intellectual development of my students (item 7, 94.1%, N=169).

Psychology (item 7) is one of the common areas which is identified as an area of confidence by elementary teachers in both countries. K-6 teachers in North Carolina feel confident in terms of professional knowledge such as pedagogy (item 8) and curriculum development (item 9). On the other hand, Japanese elementary teachers feel confident in the mathematics skills (item 4) and knowledge in science education (item 3).

In terms of perceived needs, the following items through the observation of table 2 are identified as teachers' needs by teachers in each sample.

Japan
- I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives (item 9, 59.0%, N=452).

- I possess sufficient background in non-science fields such as the humanities, social science, languages, and philosophy, to enable me to provide a wider perspective and relevant to my science teaching (item 6, 55.0%, N=449).

- I possess sufficient background in psychology to enable me to understanding the physical, emotional, and intellectual development of my students (item 7, 53.0%, N=451).

Table 2

Percentages of teachers who perceived "Strength" and "Needs"
(1) Academic background(%)

Items	JAPAN			NORTH CAROLINA		
	N	STRENGTH	NEEDS	N	STRENGTH	NEEDS
1	434	11.8	32.5	152	54.0	30.9
2	437	11.2	44.2	160	62.5	30.6
3	438	46.6	40.6	167	67.7	27.6
4	451	70.3	47.0	170	92.3	5.9
5	449	14.0	46.1	169	73.0	20.7
6	449	22.3	55.0	169	90.5	7.1
7	451	39.9	53.0	169	94.1	3.0
8	449	22.3	55.0	171	95.9	1.8
9	452	29.6	59.0	171	97.1	1.8

Items

1 I have sufficient pre-service background equivalent to a major (or minor) in each science, biology, chemistry, of physics education.

2 I have acquired in-service training that are similar to my pre-service major (or minor) in each science, biology, chemistry, of physics education

3 I possess sufficient background in area of science education other than my area of specialization.

4 I have sufficient background in the mathematics required/applicable to the science course I teach.

5 I have studied the historical development and philosophy of science, including the continuing contributions of scientists to modern world.

6 I possess sufficient background in non science fields such as the humanities, social sciences, languages, and philosophy, to enable me to provide a wider perspective and relevance to my science teaching.

7 I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students.

8 I possess knowledge and understanding of the philosophical, historical and social purpose of education.

(Cont. Table 2)

9. I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives.

North Carolina

- I have sufficient preservice background equivalent to major (or minor) in each science, biology, chemistry, or physics education. (item 1, 30.9%, N=152)

- I have acquired in inservice training equivalent to my preservice major in each science, biology, chemistry or physics education (item 2, 30.6%, N=160).

- I possess sufficient background in area of science education other than my area of specialization (item 3, 27.6%, N=167).

There are no common items between the needs of Japanese teachers and teachers in North Carolina. In Japan, the items related to pedagogical knowledge on educational purpose (item 8) and curriculum development (item 9) are identified as needs. On the other hand, science knowledge (item 1 & 2) is identified as needs by elementary teachers in North Carolina.

Similarities and differences in the self-reported academic background are summarized in Table 3. In Table 3, the items identified by samples both in Japan and in North Carolina, which are considered similarities, are listed in the middle box. The items identified by samples only in Japan, which are considered as uniquenesses of Japanese teachers, are listed in the left box. The items identified by the sample only in North Carolina, which are considered as uniquenesses of teachers in North Carolina, are listed in right box.

Table 3 Summary of similarities and differences
Academic backgrounds

(i) Frequent teachers' behavior

Japan	Similarities	North Carolina
*Science education courses > Science contents (item 3)	*Psychology (item 7) *Mathematics (item 4)	*Philosophical, historical, social purpose of education (item 8)

(Cont. Table 3)

(ii) Confidence

Japan	Similarities	North Carolina
*Science education courses > Science content (item 3) *Mathematics (item 4)	*Psychology (item 7)	*Philosophical, historical, social purpose of education (item 8) * Curriculum development (item 9)

(iii) Needs

Japan	Similarities	North Carolina
*Curriculum development (item 9) *Other disciplines than science or science education (item 6) *Psychology (item 7)		*Pre- & inservice education for science content (item 1 &2) * Science education courses > Science content (item 3)

The Self-reported Teachers Opportunities for Teacher Training.

The following items are identified as frequent teachers' behaviors in each sample, according to the observation of Table 4.

Japan
- Within the past three years, I have updated my knowledge in my specialized area (item 1, mean score 2.21, N=485).

- Within the past three years, I have attended meetings, conventions, seminars, or conference related to science teaching (item 2, mean score 2.14, N=485).

- Within the past three years, I have updated my knowledge on the development and production of conventional/ innovative science curriculum materials (item 5, mean score 1.88, N=487).

- Within the past three years, I have updated my knowledge on laboratory techniques, procedures, and safety (item 6, mean score 1.82, N=486).

North Carolina
- Within the past three years, I have updated my knowledge in my specialized area (item 1, mean score 4.12, N=174).

- Within the past three years, I have updated my knowledge on developments in student evaluation technique (item 7, mean score 3.49, N=177).

- Within the past three years, I have attended meetings, conventions, seminars, or conference related to science curriculum materials (item 2, mean score 3.47, N=180).

- Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching (item 4, 3.47, N=176).

Updating knowledge in a speciality area (item 1) and attending meetings on science teaching (item 2) are identified as frequent teachers' behaviors by elementary teachers both in Japan and North Carolina. In addition, updating knowledge on developing curriculum materials (item 5) and laboratory technique (item 6) are identified as frequent teachers' behavior in Japan. On the other hand, updating knowledge of evaluation methods (item 7) and instructional methods (item 4) are identified as frequent teachers' behaviors.

Table 4.

Mean frequency score and mean value score on each item

(2) Teachers' inservice education opportunities

Items	JAPAN*				NORTH CAROLINA*			
	EXPERIENCE	(N)	VALUE	(N)	EXPERIENCE	(N)	VALUE	(N)
1	2.21	(485)	3.16	(450)	4.12	(174)	2.79	(173)
2	2.14	(485)	3.00	(449)	3.47	(180)	2.69	(170)
3	1.52	(488)	2.83	(449)	3.00	(177)	2.57	(171)
4	1.72	(487)	2.99	(449)	3.47	(176)	2.63	(174)
5	1.88	(487)	3.00	(451)	3.29	(173)	2.54	(169)
6	1.82	(486)	3.07	(450)	2.78	(176)	2.42	(171)
7	1.51	(486)	2.93	(451)	3.49	(177)	2.57	(174)
8	1.71	(487)	2.91	(452)	3.18	(176)	2.54	(173)
9	1.04	(485)	1.92	(445)	2.56	(172)	2.38	(163)

Note * JAPAN 4 - Very often, 1 - Never in experience scale
4 - Most important, 1 - Least important in value scale
* N.C 5 - Very often, 1 - Never in experience scale
3 - High value, 1 - Low value in value scale

Items

1. Within the past three years, I have updated my knowledge in my specialized area.
2. Within the past three years, I have attended meetings, conventions, seminars, or conferences related to science teaching
3. Within the past three years, I have attended short courses, summer institutes, or similar trainings for science teachers.
4. Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching
5. Within the past three years, I have updated my knowledge on the development and production of conventional/innovative science curriculum materials
6. Within the past three years, I have updated my knowledge on laboratory techniques, procedures and safety

(Cont. Table 4)

7 Within the past three years, I have updated my knowledge on developments in student evaluation techniques.
8. Within the past three years, I have updated my knowledge on the organization and management of science classes.
9 Within the past three years, I have attended graduate school courses offered by an advanced degree-granting institution.

Concerning teachers confidence, following items are identified by elementary teachers in both samples through the observation of Table 5.

Japan

- Within the past three years, I have updated my knowledge in my specialized area (item 1, 37.4%, N=449).

- Within the past three years, I have attended meetings, conventions, seminar or conferences related to science teaching (item 2, 32.4%, N=447).

- Within the past three years, I have updated my knowledge on development and production of conventional/innovative science curriculum materials (item 5, 22.4%, N=451).

North Carolina

- Within the past three years, I have updated my knowledge in my specialized area (item 1, 89.5%, N=171).

- Within the past three years, I have updated my knowledge on the developments in student evaluation (item 7, 75.9%, N=173).

- Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching (item 4, 75.1%, N=173)

Updating specialized knowledge (item 1) is identified as an area of confidence by elementary teachers in both samples. In addition, updating the knowledge in evaluation techniques (item 7) and instructional methods (item 4) are identified as areas of confidences by the sample in North Carolina. Attending professional meetings (item 2) and updating the knowledge in development of curriculum materials (item 5) are identified as confidences.

The following items are identified as needs related to teachers opportunities for training in Japan and North Carolina through the observation of Table 5.

Japan
- Within the past three years, I have updated my knowledge on laboratory techniques, procedure and safety (item 6, 72.5%, N=450).

- Within the past three years, I have updated my knowledge on developments in student evaluation techniques (item 7, 73.6%, N=450).

- Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching (item 4, 68.7%, N=448).

North Carolina
- Within the past three years, I have attended graduate courses offered by an advanced degree-granting institution (item 9, 36.6%, N=173).

- Within the past three years,, I have updated my knowledge on laboratory techniques, procedure and safety (item 6, 35.3% N=170).

- Within the past three years, I have attended short courses, summer institutes, or similar training for science teachers (item 3, 32.2%, N=176).

Teachers' need for updating the knowledge on laboratory skills (item 6) is identified by elementary teachers in both samples. In addition, needs for updating the knowledge on evaluation techniques (item 7) and updating the knowledge of instructional methods (item 4) are identified by the sample in

Table 5

Percentages of teachers who perceived "Strength" and "Needs"
(2) Teachers' inservice education opportunities (%)

Items	JAPAN			NORTH CAROLINA		
	N	STRENGTH	NEEDS	N	STRENGTH	NEEDS
1	449	37.4	54.6	171	89.5	9.4
2	447	32.4	52.6	170	75.9	22.9
3	449	13.1	61.0	171	65.5	32.2
4	448	18.9	68.7	173	75.1	23.1
5	451	22.4	63.9	168	74.4	22.0
6	450	17.6	72.5	170	53.7	35.3
7	450	10.5	73.6	173	77.5	19.1
8	451	15.1	66.1	172	68.6	25.6
9	444	0.7	20.1	161	46.0	36.6

Items

1. Within the past three years, I have updated my knowledge in my specialized area
2. Within the past three years, I have attended meetings, conventions, seminars, or conferences related to science teaching.
3. Within the past three years, I have attended short courses, summer institutes, or similar trainings for science teachers.
4. Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching.
5. Within the past three years, I have updated my knowledge on the development and production of conventional/innovative science curriculum materials.
6. Within the past three years, I have updated my knowledge on laboratory techniques, procedures and safety.
7. Within the past three years, I have updated my knowledge on developments in student evaluation techniques.
8. Within the past three years, I have updated my knowledge on the organization and management of science classes.
9. Within the past three years, I have attended graduate school courses offered by an advanced degree-granting institution

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Japan. On the other hand, needs for participating in graduate courses (item 9) and short term inservice training (item 3) are identified as teachers needs by samples in North Carolina.

Similarities and differences in the self-reported teachers' opportunity for training are summarized in Table 6. In Table 6, the items identified by elementary teachers both in Japan and North Carolina, which are considered as similarities, are listed in the middle box. The items identified by elementary teachers only in Japan, which are considered as uniqueness of Japanese teachers, are listed in the left box. The items identified by elementary teachers only in North Carolina, which are considered as uniqueness of teachers in North Carolina are listed in right box.

Table 6 Summary of similarities and differences Teachers' inservice education opportunities

(1) Frequent teachers' behavior

Japan	Similarities	North Carolina
*Developing curriculum material (item 5) *Laboratory technique (item 6)	*Specialized area (item 1) *Attending professional meeting (item 2)	*Evaluation techneque (item 7) *Instructional methods (item 4)

(Cont. Table 6)

(ii) Confidence

Japan	Similarities	North Carolina
*Developing curriculum material (item 5) *Attending professional meeting (item 2)	*Specialized area (item 1)	*Evaluation techneque (item 7) *Instructional methods (item 4)

(iii) Needs

Japan	Similarities	North Carolina
*Evaluation technique (item 7) *Instructional methods (item 4)	*Laboratory technique (item 6)	*Attending short courses (item 3) *Attending graduate courses (item 9)

<u>The Self-reported Teacher Autonomy in Acquiring Knowledge and Skills in Teaching</u>

In terms of teacher autonomy, the following items are identified as frequent teachers' behavior in Japan and in North Carolina through the observation of Table 7.

Japan
- I always strive to give my best when I teach and prepare for my science class. (item 7, mean score 3.17, N=487)

- Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education (item 9, mean score 3.03, N=477).

- I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community (item 10, mean score 2.82, N=478).

- I regularly read journals and other publications concerned with science teaching, scientific developments, and science related issues (item 2, mean score 2.81, N=486).

Table 7

Mean frequency score and mean value score on each item

(3) Teacher's autonomy in acquiring knowlege and skills in teaching

Items	JAPAN*		NORTH CAROLINA*	
	EXPERIENCE (N)	VALUE (N)	EXPERIENCE (N)	VALUE (N)
1	2.64 (486)	3.13 (455)	4.13 (179)	2.76 (176)
2	2.81 (486)	2.76 (451)	3.34 (179)	2.55 (173)
3	2.00 (487)	2.66 (452)	3.27 (180)	2.44 (171)
4	2.07 (487)	3.04 (455)	3.16 (177)	2.36 (168)
5	1.31 (485)	2.16 (445)	1.23 (177)	1.54 (163)
6	1.55 (485)	2.50 (442)	2.61 (176)	2.20 (162)
7	3.17 (487)	3.58 (456)	4.56 (179)	2.93 (173)
8	2.35 (441)	2.64 (414)	4.20 (173)	2.77 (164)
9	3.03 (477)	3.42 (456)	4.80 (177)	2.95 (170)
10	2.82 (478)	3.30 (457)	4.68 (177)	2.91 (173)
11	2.73 (461)	3.32 (447)	4.50 (175)	2.72 (167)
12	2.24 (451)	2.62 (441)	4.21 (179)	2.63 (172)
13	2.46 (487)	3.32 (459)	4.19 (176)	2.83 (169)
14	1.12 (489)	2.51 (454)	1.58 (179)	1.95 (165)

Note * JAPAN 4 – Very often, 1 – Never in experience scale
4 – Most important, 1 – Least important in value scale
* N.C. 5 – Very often, 1 – Never in experience scale
3 – High value, 1 – Low value in value scale

Items

1 I am abreast with on going curriculum projects and related developments in my teaching field

(Cont. Table 7)

2. I regularly read journals and other publications concerned with science teaching, scientific developments, and science related issues
3. I make an effort to contact professionals and organizations (local, national, international) in my field to provide enrichment to my teaching.
4. I extend my knowledge and understanding of students and their environment thru constant visitations and contacts with individuals and organizations in the community
5. Within the past three years, I have submitted at least one article or other manuscript related to science teaching for publication in a professional journal or other publications
6. Within the past three years, I have participated in educational projects (curriculum research study, development of innovative curriculum materials, etc.)
7. I always strive to give my best when I teach and prepare for my science class.
8. I am proud of being a science teacher.
9. Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education
10. I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community
11. Inquisitiveness, open-mindedness, generosity, and a well-directed sense of aggressiveness are necessary traits of a science teacher.
12. Leadership is an invaluable quality of a science teacher.
13. I have developed instructional materials suited to student ability levels and relevant to classroom objectives.
14. I have developed microcomputer based science lessons for my class.

- Inquisitiveness, open-mindedness, generosity and a well directed sense of aggressiveness are necessary traits of a science teacher (item 11, mean score 2.73, N=461).

North Carolina

- Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education (item 9, mean score 4.80, N=177).

- I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community (item 10, mean score 4.68, N=177).

- I always strive to give my best when I teach and prepare for my science class (item 7, mean score 4.56, N=178).

- Inquisitiveness, open-mindedness, generosity and a well directed sense of aggressiveness are necessary traits of a science teacher (item 11, mean score 4.50, N=175).

- Leadership is an invaluable quality of science teachers (item 12. mean score 4.21, N=179).

Doing the best (item 7), love for children (item 9), developing a cooperative relationship (item 10), and positive attitude (item 11) are identified as frequent teachers behaviors by both samples. In addition taking leadership (item 12) is identified as frequent teachers behavior by the sample in North Carolina. On the other hand, regular reading of professional journals or other publications (item 2) is identified as frequent teachers behavior by Japanese teachers.

With regard to teachers confidences, the following items are identified by teachers in each sample through the observation of Table 8.

Japan
- I always strive to give my best when I teach and prepare for my science class (item 7, 84.6%, N=454).

- Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education (item 9, 70.8%, N=448).

- I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community (item 10, 63.8%, N=456).

- Inquisitiveness, open mind, generosity, and a well-directed sense of aggressiveness are necessary traits of science teachers (item 11, 57.9%, N=432).

- I am abreast with on-going curriculum projects and related developments in my teaching field (item 1, 51.2%, N=453).

North Carolina
- I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community (item 10, 99.4%, N=172)

- Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education (item 9, 98.2%, N=162).

- I always strive to give my best when I teach and prepare for my science class (item 7, 97.7%, N=171).

- I am abreast with on-going curriculum projects and related developments in my teaching field (item 1, 93.7%, N=175).

"Collaboration (item 10)", "Doing best (item 7)", "Positive attitude in daily life (item 11)", "Love for children (item 9)", and "paying attention to on-going Curriculum projects (item 1)" are identified as teachers' area of confidence by elementary teachers in Japan and North Carolina.

The following items are identified as teachers' needs related by the samples in Japan and North C .rolina through the observation of Table 8.

Japan

- I extend my knowledge and understanding of students and their environment thru constant visitations and contacts with individuals and organizations in the community (item 4, 64.1% N=454).

- I have developed instructional materials suited to student ability levels and relevant to classroom objectives (item 13, 56.5% N=451).

- I have developed microcomputer based science lessons for my class (item 14, 50.33% N=449).

- I make an effort to contact professionals and organizations (local, national, international) in my field to provide enrichment on my teaching (item 3, 49.1% N=452).

- Within the past three years, I have participated in educat[illegible] projects (curriculum, research study, development of innovative curriculum materials, etc.) (item 6, 40.8% N=439).

Table 8

Percentages of teachers who perceived "Strength" and "Needs"
(3) Teachers autonomy for acquiring knowledge and skills

Items	JAPAN			NORTH CAROLINA		
	N	STRENGTH	NEEDS	N	STRENGTH	NEEDS
1	453	51.2	38.0	175	93.7	5.1
2	450	37.1	32.2	172	76.2	22.1
3	452	27.2	49.1	171	71.4	21.1
4	454	21.8	64.1	167	73.6	18.0
5	442	4.1	26.3	163	6.8	33.1
6	439	13.0	40.8	162	57.3	25.9
7	454	84.6	14.6	171	97.7	1.2
8	407	41.5	25.6	163	94.5	3.1
9	448	70.8	23.0	169	98.2	0.6
10	456	63.8	27.3	172	99.4	0.0
11	432	57.9	34.5	166	98.2	0.0
12	422	30.6	26.3	171	93.6	2.3
13	451	40.9	56.5	169	83.6	4.7
14	449	2.2	50.3	165	18.8	50.9

Items

1 I am abreast with on going curriculum projects and related developments in my teaching field

2 I regularly read journals and other publications concerned with science teaching, scientific developments, and science related issues

3 I make an effort to contact professionals and organizations (local, national, international) in my field to provide enrichment to my teaching

4 I extend my knowledge and understanding of students and their environment thru constant visitations and contacts with individuals and organizations in the community

(Cont. Tble 8)

5 Within the past three years, I have submitted at least one article or other manuscript related to science teaching for publication in a professional journal or other publications
6 Within the past three years, I have participated in educational projects (curriculum research study, development of innovative curriculum materials, etc.)
7 I always strive to give my best when I teach and prepare for my science class
8 I am proud of being a science teacher
9 Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education
10 I know how to establish cooperation and maintain harmonious relationships with others in the school and in the community
11 Inquisitiveness, open-mindedness, generosity, and a well-directed sense of aggressiveness are necessary traits of a science teacher
12 Leadership is an invaluable quality of a science teacher
13 I have developed instructional materials suited to student ability levels and relevant to classroom objectives
14 I have developed microcomputer based science lessons for my class

North Carolina
- I have developed microcomputer based science lessons for my class (item 14. 50.9% N=165).

- Within the past three years, I have submitted at least one article or other manuscript related to science teaching for publication in a professional journal or other publications (item 5, 33.1% N=163).

- Within the past three years, I have participated in educational projects (curriculum, research study, development of innovative curriculum materials, etc.) (item 6, 25.9% N=170).

- I regularly read journals and other publications concerned with science teaching, scientific developments and science related issues (item 2. 22.1% N=172).

- I make an effort to contact professionals and organizations (local, national, international) in my field to provide enrichment on my teaching (item 3. 21.1% N=171).

Interaction with professional people (item 3) participating in educational projects (item 6), and developing computer based science lessons (item 14) are identified as needs by both samples. In addition, need for interaction with the local communities (item 4) and developing instructional materials (item 13) are identified by Japanese samples. On the other hand, need for reading professional publications (item 2) and writing professional papers (item 5) are identified by the sample in North Carolina.

Similarities and differences in self-reported teacher autonomy are summarized in Table 9. The items identified in both samples, which are considered as similarities, are listed in the middle box. The items identified only in Japan, which are considered as uniqueness of Japanese teachers, are listed in the left box. The items identified only in North Carolina, which are considered as uniquenesses of teachers in North Carolina, are listed in right box.

Table 9 Summary of similarities and differences
Autonomy for acquiring the knowledge and skills

(i) Frequent teachers' behavior

Japan	Similarities	North Carolina
*Reading journals (item 11)	*Doing the best (item 7) *Love for children (item 9) *Collaboration (item 10) *Inquisitiveness (item 11)	*Leadership (item 12)

(ii) Confidence

Japan	Similarities	North Carolina
	*Collaboration (item 10) *Doing best (item 7) *Inquisitiveness (item 11) *Love for children (item 9) *Paying the attention to on-going curriculum (item 1)	

(iii) Needs

Japan	Similarities	North Carolina
*Interaction with children (item 4) *Developing Instructional materials (item 13)	*Interaction with Professionals (item 3) *Participating educational project (item 6) *Developing computer based class (item 14)	*Reading journals (item 2) *Submitting professional paper (item 5)

The self reported objectives

The following items are identified as frequent teachers' behavior in Japan and North Carolina, through the observation of Table 10.

Japan

- I encourage children to be aware of and respond in a positive manner to beauty and orderliness in his/her environment (item 3, mean score 3.10 , N=489).

- I encourage children to acquire the ability to observe things and events in order to perceive and identify them (item 10, mean score 3.09, N=486).

- I always allow children to sense and formulate the existence of problem (item 2. mean score 3.04, N=490).

- I always give children the chance to be intrigued by objects and events in his/her environment and be curious about his/her surroundings (item 1. mean score 2.93, N=489).

- I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of the data at hand (item 5. mean score 2.83, N=487).

North Carolina

- I encourage children to acquire the ability to observe things and events in order to perceive and identify them (item 10, mean score 4.42, N=176).

- I encourage children to be aware of and respond in a positive manner to beauty and organization in his/her environment (item 3, mean score 4.28, N=179).

- I always give children the chance to be intrigued by objects and events in his/her environment (item 1, mean score 4.23, N=181).

- I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand (item 5, mean score 4.18, N=181).

- I allow children to have a critical and questioning attitude toward unsupported inferences and hypothesis (item 6, mean score 4.14, N=178).

Table 10

Mean frequency score and mean value score on each item

(4) Objectives

Items	JAPAN				NORTH CAROLINA			
	EXPERIENCE	(N)	VALUE	(N)	EXPERIENCE	(N)	VALUE	(N)
1	2.93	(489)	3.15	(466)	4.23	(181)	2.80	(180)
2	3.04	(490)	3.59	(466)	3.82	(179)	2.70	(174)
3	3.10	(489)	3.61	(467)	4.28	(179)	2.75	(179)
4	2.61	(489)	3.21	(465)	3.94	(180)	2.66	(180)
5	2.83	(490)	3.35	(465)	4.18	(181)	2.72	(180)
6	2.25	(487)	2.72	(465)	4.14	(178)	2.64	(176)
7	2.50	(489)	2.92	(463)	3.74	(176)	2.53	(173)
8	2.36	(486)	2.96	(460)	4.04	(176)	2.66	(174)
9	1.54	(485)	2.20	(459)	3.48	(173)	2.34	(170)
10	3.09	(486)	3.56	(465)	4.42	(176)	2.81	(175)
11	2.60	(489)	3.16	(465)	3.80	(177)	2.54	(176)
12	2.35	(488)	3.07	(465)	3.58	(178)	2.48	(177)
13	2.25	(489)	2.96	(466)	3.67	(178)	2.56	(175)
14	2.66	(489)	3.28	(465)	3.11	(177)	2.47	(174)
15	1.71	(486)	2.45	(463)	3.12	(177)	2.30	(176)
16	2.15	(487)	2.81	(464)	4.06	(179)	2.67	(178)
17	2.58	(489)	3.32	(465)	3.82	(177)	2.57	(176)
18	2.38	(488)	3.07	(463)	3.58	(179)	2.54	(174)

Note JAPAN 4 - Very often, 1 - Never in experience scale
4 - Most important, 1 - Least important in value scale
N.C. 5 - Very often, 1 - Never in experience scale
3 - High value, 1 - Low value in value scale

(Cont. Table 10)

Items

1. I always give children the chance to be intrigued by objects and events in his/her environment.
2. I always allow children to sense and formulate the existence of a problem.
3. I encourage children to be aware of and respond in a positive manner to beauty and organization in his/her environment.
4. I allow children to use rational and creative thinking abilities when attempting to explain discrepant events, and point out contradictions among seemingly unrelated phenomena.
5. I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand.
6. I allow children to have a critical and questioning attitude toward unsupported inferences and hypotheses (Belief in cause and effect).
7. I encourage children to always test hypotheses in a rational manner.
8. I allow children to appreciate the inter-relatedness of science, technology, and society.
9. I encourage children to recognize the limitations of scientific modes of inquiry, and their awareness for need of different approaches as affected by economic, psychological, or religious factors in any proposed solutions.
10. I encourage children to acquire the ability to observe things and events in order to perceive and identify them.
11. I encourage children to acquire the ability to sort out for classification and formulate tentative inferences and hypotheses to identify and explain natural phenomena.
12. I encourage children to acquire the ability to recall the proper experiences and generate relevant data to verify tentative if-then statements and suggest procedures for testing it experimentally.
13. I encourage children to acquire the ability to gather descriptive and quantitative information needed for developing or testing hypotheses.
14. I allow children to have plenty of chance to design and construct laboratory experiments and apparatus, in order to obtain data, verify hypotheses, and select suitable materials, equipment, etc...
15. I encourage children to identify the variables that materially influence given instructions in a system and formulate the critical model for explanation.
16. I encourage children to demonstrate knowledge of facts, conventions, sequences, classifications, criteria, and draw on the knowledge of concepts, laws and principles for use in classroom and in their environment.
17. I encourage children to apply generalizations to specific cases and to develop further investigations in daily life technology and society.
18. I encourage children to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study, process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his/her readers or listeners.

Developing curiosity (item 1) and appreciation for nature (item 3), observation skills (item 10) and empirical explanations skills (item 5) are identified in both samples. In addition, sensing and formulating the existence of problems (item 2) are identified as teachers frequent behaviors by the Japanese samples. On the other hand, critical and questioning attitude toward unsupported inferences (item 6) are identified as frequent behaviors by samples in North Carolina.

The following items are identified as confidences by samples in Japan and in North Carolina, as shown in Table 11.

Japan
- I encourage children to acquire the ability to observe things and events in order to perceive and identify them (item 10, 80.7%, N=465).

- I always allow children to sense and formulate the existence of a problem (item 2, 79.4%, N= 446).

- I encourage children to be aware of and respond in a positive manner to beauty and organization in his/her environment (item 3, 77.0%, N=446).

- I always give children chance to be intrigued by objects and events in his/her environment (item 1, 74.4%, N=465).

- I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand (item 5, 64.1%, N=465).

North Carolina
- I always give children chance to be intrigued by objects and events in his/her environment (item 1, 100.0%, N=180).

- I encourage children to be aware of and respond in a positive manner to beauty and organization in his/her environment (item 3, 99.4%, N=178).

- I encourage children to acquire the ability to observe things and events in order to perceive and identify them (item 10, 98.9%, N=175).

- I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand (item 5, 97.2%, N=180).

- I always allow children to sense and formulate the existence of a problem (item 2, 97.1%, N=174).

Developing curiosity (item 1) and appreciation for nature (item 3), observation skills (item 10), empirical explanations skills (item 5) and sensing and formulating the existence of problems (item 2) are identified in both samples.

The following items are identified as needs by teachers in Japan and North Carolina, through the observation of Table 11.

Japan

- I encourage children to acquire the ability to recall the proper experiences and generate relevant data to verify tentative if-then statements and suggest procedures for testing it experimentally (item 12, 49.7%, N=465).

- I encourage children to acquire the ability to gather descriptive and quantitative information needed for developing or testing hypotheses (item 13, 47.7%, N=465).

- I encourage children to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study, process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his/her readers or listeners (item 18, 43.4%, N=463).

North Carolina

- I allow children to have plenty of chances to design and construct laboratory experiments and apparatus, in order to obtain data, verify hypotheses, and select suitable materials, equipment, etc (item 14, 20.7%, N=174).

- I encourage children to identify the variables that materially influence given instruction in a system and formulate the critical model for explanation (item 15, 16.5%, N=176).

- I encourage children to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study, process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his/her readers or listeners (item 18, 11.5% N=174).

Table 11

Percentages of teachers who perceived "Strength" and "Needs"

(4) Objectives (3)

items	JAPAN			NORTH CAROLINA		
	N	STRENGTH	NEEDS	N	STRENGTH	NEEDS
1	465	74.4	24.9	180	100.0	0.0
2	446	79.4	19.8	174	97.1	2.9
3	446	77.0	22.1	178	99.4	0.6
4	465	52.7	39.1	179	66.7	2.2
5	465	64.1	30.3	180	97.2	1.7
6	464	30.8	38.8	176	94.8	0.6
7	463	46.0	31.3	173	90.2	4.1
8	460	38.7	39.1	174	95.4	1.1
9	458	5.6	25.1	170	85.3	5.9
10	465	80.7	17.6	175	98.9	0.6
11	465	54.2	35.8	176	93.[illegible]	4.0
12	465	38.0	49.7	177	87.6	7.3
13	465	33.3	47.7	175	89.2	7.4
14	465	54.0	39.4	174	70.7	20.7
15	461	12.4	43.0	176	73.9	16.5
16	463	28.9	42.3	178	93.3	3.9
17	464	50.0	42.5	176	90.9	5.1
18	463	39.1	43.4	174	83.3	11.5

(Cont. Table 11)

Items

1. I always give children the chance to be intrigued by objects and events in his/her environment.
2. I always allow children to sense and formulate the existence of a problem.
3. I encourage children to be aware of and respond in a positive manner to beauty and organization in his/her environment.
4. I allow children to use rational and creative thinking abilities when attempting to explain discrepant events, and point out contradictions among seemingly unrelated phenomena.
5. I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand.
6. I allow children to have a critical and questioning attitude toward unsupported inferences and hypotheses (Belief in cause and effect).
7. I encourage children to always test hypotheses in a rational manner.
8. I allow children to appreciate the inter-relatedness of science, technology, and society.
9. I encourage children to recognize the limitations of scientific modes of inquiry, and their awareness for need of different approaches as affected by economic, psychological, or religious factors in any proposed solutions.
10. I encourage children to acquire the ability to observe things and events in order to perceive and identify them.
11. I encourage children to acquire the ability to sort out for classification and formulate tentative inferences and hypotheses to identify and explain natural phenomena.
12. I encourage children to acquire the ability to recall the proper experiences and generate relevant data to verify tentative if-then statements and suggest procedures for testing it experimentally.
13. I encourage children to acquire the ability to gather descriptive and quantitative information needed for developing or testing hypotheses.
14. I allow children to have plenty of chance to design and construct laboratory experiments and apparatus, in order to obtain data, verify hypotheses, and select suitable materials, equipment, etc...
15. I encourage children to identify the variables that materially influence given instructions in a system and formulate the critical model for explanation.
16. I encourage children to demonstrate knowledge of facts, conventions, sequences classifications, criteria, and draw on the knowledge of concepts, laws and principles for use in classroom and in their environment.
17. I encourage children to apply generalizations to specific cases and to develop further investigations in daily life technology and society.
18. I encourage children to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study, process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his/her readers or listeners.

Commonly identified teachers need in both samples is only developing communication skills (item 18). Inquiry skills related to planning and implementing an investigation (item 12) and a science process skills related to gathering data and information (item 13) are identified as teachers' needs by Japanese sample. Designing experiment (item 14) and identifying variables (item 15) are identified as teachers needs among objectives by North Carolina samples.

Similarities and differences in self reported teaching objectives are summarized in Table 12. In Table 12, the items identified in both samples, which are considered as similarities, are listed in the middle box. The items identified in Japanese samples, which are considered as uniqueness of Japanese teachers, are listed in the left box. The items identified in North Carolina samples, which are considered as uniquenesses of teachers in North Carolina, are listed in right box.

Table 12 Summary of similarities and differences

Objectives

: Frequent teachers' behavior

Japan	Similarities	North Carolina
* Sensing & formulating the existence of problem (item 2)	*Curiosity (item 1) & appreciation for nature (item 3) * Observation (item 10) * Explanaiton (item 5)	* Critical thinking skills & questioning attitude (item 6)

(Cont. Table 12)

(ii) Confidence

Japan	Similarities	North Carolina
	*Curiosity (item 1) & appreciation for nature (item 3) * Observation (item 10) * Explanaiton (item 5) * Sensing & formulating the existence of problem (item 2)	

(iii) Needs

Japan	Similarities	North Carolina
* Gathering data & information (item 13) *Inquiry skills (item 12)	*Communication (item 18)	*Designing experimentation (item 14) *Identifying variables (item 15)

<u>The Self-reported Teaching Methods and Strategies</u>

The following items are identified as frequent teachers' behavior by samples in Japan and in North Carolina through the observation of Table 13.

Japan

- I utilize various teaching facilities such as laboratory classroom, and school grounds in my class (item 2, mean score 3.37, N=490).

- I utilize various teaching strategies such as problem solving, case studies and demonstrations in my class (item 1, mean score 2.96, N=489).

Table 13

(5) Teaching methods and strategies

Items	JAPAN*		NORTH CAROLINA*	
	EXPERIENCE (N)	VALUE (N)	EXPERIENCE (N)	VALUE (N)
1	2.96 (489)	3.37 (460)	4.34 (179)	2.81 (176)
2	3.37 (490)	3.44 (460)	4.09 (179)	2.77 (176)
3	2.07 (488)	3.10 (459)	3.43 (178)	2.59 (175)
4	2.57 (490)	3.12 (458)	4.27 (180)	2.74 (176)
5	1.19 (490)	2.57 (456)	2.84 (177)	2.41 (174)
6	2.46 (485)	3.00 (461)	3.90 (178)	2.67 (174)

Note * JAPAN 4 – Very often, 1 – Never in experience scale
4 – Most important, 1 – Least important in value scale
* N C 5 – Very often, 1 – Never in experience scale
3 – High value, 1 – Low value in value scale

Items

1. I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class
2. I utilize various teaching facilities such as laboratory, classroom, and school grounds in my class
3. I utilize various facilities available in the community such as science centers, museums, and natural areas in my class
4. I make use of audiovisual devices and materials for teaching.
5. I make use of a computer to teach selected science topics
6. I use various kinds of evaluation instruments to measure cognitive, process skills, and attitudes

North Carolina

- I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class (item 1, mean score 4.34, N=179).

- I make use of various kinds of audiovisual devices and materials for teaching (item 4, mean score 4.27, N=180).

Utilizing various teaching strategies (item 1) is identified as frequent teachers' behavior by the samples in Japan and in North Carolina. In addition, using the school facilities (item 2) is identified as teachers' frequent behavior by the sample in Japan. On the other hand, using audiovisual equipment (item 4) is identified as frequent teachers' behavior by the sample in North Carolina.

The following items are identified as teachers' areas of confidences by the sample in each country through the observation of Table 14.

Japan

- I make use of various facilities such as laboratory, classroom, and school grounds in my class (item 2, 89.6%, N=460).

- I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class (item 1, 70.2%, N=459).

North Carolina

- I make use of audiovisual devices and materials for teaching (item 4, 98.3%, N=178).

- I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class (item 1, 97.2%, N=176).

Utilizing various kinds of teaching strategies (item 1) is identified as teachers' confidence in both samples. In addition, using the school facilities (item 2) is identified as teachers' confidence by the sample in Japan. On the other hand, using audiovisual equipment (item 4) is identified as teachers' confidence by the sample in North Carolina.

Table 14

Percentages of teachers who perceived "Strength" and "Needs"

(5) Teaching methods and strategy (%)

Items	JAPAN			NORTH CAROLINA		
	N	STRENGTH	NEEDS	N	STRENGTH	NEEDS
1	459	70.2	24.6	176	97.2	1.1
2	460	69.6	8.0	176	96.0	2.8
3	456	20.3	69.4	174	82.8	14.9
4	456	47.2	43.0	178	98.3	0.6
5	456	2.9	52.4	174	61.0	29.8
6	457	68.5	11.6	174	94.3	4.6

Items

1. I utilize various teaching strategies such as inquiry, case studies, and demonstrations in my class.
2. I utilize various teaching facilities such as laboratory, classroom, and school grounds in my class.
3. I utilize various facilities available in the community such as science centers, museums, and natural areas in my class.
4. I make use of audiovisual devices and materials for teaching.
5. I make use of a computer to teach selected science topics.
6. I use various kinds of evaluation instruments to measure cognitive, process skills, and attitudes.

The following items are identified as teachers' needs in each sample through the observation of Table 14.

Japan

- I utilize various facilities available in the community such as science centers, museums, and natural areas in class (item 3, 69.4%, N=458).

- I make use of a computer to teach selected science topics (item 5, 52.4%, N=456).

North Carolina
- I make use of a computer to teach selected science topics (item 5, 29.8%, N=176).

- I utilize various facilities available in the community such as science centers, museums, and natural areas in class (item 3, 14.9%, N=174).

Using a computer (item 5) and using the facilities outside of schools (item 3) are identified as teachers needs by both samples.

Similarities and differences in self reported teaching methods and strategies are summarized in Table 15. In Table 15, the items identified in both samples, which are considered as similarities, are listed in the middle box. The items identified by the Japanese sample, which are considered as uniqueness of Japanese teachers, are listed in the left box. The items identified by the North Carolina sample, which are considered as uniqueness of teachers in North Carolina, are listed in right box.

Table 15 Summary of similarities and differences

Teaching methods and strategies

(i) Frequent teachers' behavior

Japan	Similarities	North Carolina
*Using facilities in school (item 2)	*Various teaching strategies (item 1)	*Using audiovisual equipment (item 4)

(ii) Confidence

Japan	Similarities	North Carolina
*Using facilities in school (item 2)	*Various teaching strategies (item 1)	*Using audiovisual equipment (item 4)

(iii) Needs

Japan	Similarities	North Carolina
	*Using the facilities in their community (item 3) *Using computer (item 5)	

Major findings

The analysis of elementary science teachers self-reported activities resulted in identifying the following similarities and differences in Japan and North Carolina.

1. Academic background

Similarities

- Possessing the knowledge in psychology and Mathematics is perceived as a strong background by elementary science teachers in Japan and North Carolina.

- Possessing the knowledge in Psychology is perceived as aconfident area of background by elementary science teachers.

Differences

- Possessing a strong background in science education rather than science content is perceived as one of the frequent behaviors by the sample in Japan. On the other hand, possessing the strong background is perceived as one of the frequent behaviors by the sample in North Carolina.

- Japanese elementary teachers feel confident in the mathematics skills and knowledge in science education. On the other hand K-6 teachers in North Carolina feel confident in terms of professional knowledge such as pedagogy and curriculum development.

- In Japan, the items related to general knowledge and pedagogical knowledge are perceived as needs. On the other hand, science knowledge is perceived as needs by elementary teachers in North Carolina.

2. Teachers' Opportunities for Training

Similarities

- Updating knowledge in one's speciality area and attending meetings on science teaching are perceived as frequent teachers' behaviors by elementary teachers both in Japan and North Carolina.

- Updating specialized knowledge is perceived as a confidence by elementary teachers in both samples.

- Updating the knowledge about laboratory skills is perceived as a need by elementary teachers in both samples.

Differences

- Updating knowledge on developing curriculum materials and laboratory technique are perceived frequent teachers' behavior in Japan. On the other hand, updating knowledge of evaluation methods and instructional methods are perceived as frequent teachers behaviors.

- Updating the knowledge in evaluation techniques and instructional methods are perceived as teachers' confidences by the sample in North Carolina. Attending the professional meetings and updating the knowledge in development of curriculum material are identified as teachers' confidences.

- Needs for updating the knowledge on evaluation techniques and updating the knowledge of instructional methods are perceived by the sample in Japan. On the other hand, needs for participating graduate courses and short term inservice training are perceived as teachers needs by samples in North Carolina.

3. Teachers' Autonomy for Acquiring the Knowledge and Skills in Teaching

Similarities

- Doing the best, love for children, developing a cooperative relationship, and positive attitude are perceived as frequent teachers' behaviors by both samples.

- "Collaboration", "Doing best", "Positive attitude in daily life", "Love for children", and "paying attention to on-going curriculum projects" are perceived as teachers' confidences by elementary teachers in Japan and North Carolina.

- Interaction with professional people, participating with educational projects, and developing computer based science lessons are perceived as needs by both samples.

Differences

- Taking leadership is perceived as frequent teachers' behavior by the sample in North Carolina. On the other hand, regular reading of professional journals or other publications is perceived as frequent teachers' behavior by Japanese teachers.

- Needs for interaction with the local communities and developing the instructional materials are perceived by the Japanese samples. On the other hand, needs for reading professional publications and and writing professional papers are perceived by the sample in North Carolina.

4. Teaching Objectives

Similarities

- Developing curiosity and appreciation for nature, observation skills and empirical explanations skills are perceived in both samples.

- Developing curiosity and appreciation for nature, observation skills, empirical explanations skills and sensing and formulating the existence of problems are perceived as teachers' confidences in both samples.

- Commonly perceived as teachers' need in both samples is developing communication skills.

Differences

- Sensing and formulating the existence of problems is perceived as teachers' frequent behavior by the Japanese sample. On the other hand, critical and questioning attitudes toward unsupported inferences is perceived as frequent teachers behavior by the sample in North Carolina.

- Inquiry skills related to planning and implementing an investigation and science process skills related to gathering data and information are perceived as teachers' needs by the Japanese sample. Designing experiments and identifying variables are perceived as teachers needs among objectives by the sample in North Carolina.

5. Science Teaching Methods

Similarities

- Utilizing various teaching strategies is perceived as frequent teachers behavior by the samples in Japan and in North Carolina.

- Utilizing various kinds of teaching strategies is perceived as teachers confidence in both samples.

- Using computer and using the facilities outside of schools are perceived as teachers' needs by both samples.

Differences

- Using the school facilities is perceived as teachers frequent behavior by the sample in Japan. On the other hand, using audiovisual equipment is perceived as frequent teachers behavior by the sample in North Carolina.

- Using the school facilities is perceived as a teachers' area of confidence by the sample in Japan. On the other hand, using audiovisual equipment is perceived as teachers confidence by the sample in North Carolina.

Chapter 5

Discussion and Conclusion

This chapter includes:

a) A Discussion of Research Questions

b) Limitation of This Study

c) Conclusion Based on the Results

A Discussion of Research Questions

Research Question 1. What are the identifiable differences, if any, in the self-reported academic backgrounds of elementary science teachers in Japan and North Carolina?

This study revealed that elementary teachers in both samples perceived that they have weak backgrounds in science content. This study also revealed that Japanese teachers perceived confidence in science education rather than broader perspectives of education. Japanese elementary teachers perceived the need for having the broader perspectives such as knowledge and skills on curriculum development, and non-science disciplines. Yoshida (1990) indicated that there is a lack of professors teaching pedagogy such as curriculum theories in non-teacher training institutions in Japan. Teachers in North Carolina are confident in curriculum development and the broader perspectives of education. Japanese faculties, lead teachers, and administrators should look for effective ways to make teachers confident in pedagogical knowledge.

With regard to science education courses, this study revealed that American teachers perceived a need for science education courses. According to the survey of American teachers in the United States -Japan Cooperative project, 97% of preservice institutions (N=185) are offering less than 5 semester hours of science education courses to prospective elementary teachers (Coble, C. R., Mattheis, F. E., & Spooner, W.E., 1990).

On the other hand, Japanese elementary teachers perceived that they are confident in the area of science education. Though this study revealed that Japanese elementary teachers are confident in their science education background other than their science content background, it was reported by Nakayama (1990) that, even in elementary preservice programs, there is more attention to academic science courses and less attention to integrating science courses into education. There seems to be need for developing and offering enough science education courses which integrate science and education.

Research Question 2. What are the identifiable differences, if any, in the self-reported teachers' inservice education opportunities of elementary science teachers in Japan and North Carolina?

This study revealed that teachers in both samples perceived they are frequently updating their specialized knowledge. It should be noted that this does not always mean they are updating their knowledge in science content. In the questionnaire, it was written "*Within the past three years, I have updated my knowledge in my specialized area.*" However, other items in this survey refer to inservice programs related to science teaching.

According to data from the self-report type questionnaire, American teachers are more likely to attend academic courses to update knowledge than Japanese teachers are. This difference might be attributed to the availability of graduate schools to teachers. In North Carolina, there are many night-time graduate programs. On the other hand, though each Japanese graduate school allows teachers to come and study as full-time students, only three universities are providing graduate courses (Hyogo Kyouiku University, Naruto Kyouiku University, and Joetsu Kyouiku University) for classroom teachers.

Research Question 3. What are the identifiable differences, if any, in the self-reported teachers' autonomy for acquiring the knowledge and skills in teaching of elementary science teachers in Japan and North Carolina?

In terms of implementation and confidence, behavior of teachers in both samples are similar, except Japanese teachers are likely to read journals and American teachers tend to place heavier emphasis on leadership than Japanese teachers.

When needs are examined, there are different tendencies of teachers in each area. Japanese teachers perceived a need on the items related to understanding the children through their teaching activities in classrooms such as item 4 (*understanding of children thru visitation*) and item 13 (*developing Instructional Materials*). American teachers perceived needs on the items related to professional work such as item 2 (*reading journals*) and item 5 (*submitting professional papers*).

Research Question 4. What are the identifiable differences, if any, in the teachers self-reported teaching objectives for their science lessons in Japan and North Carolina

With regard to frequency and confidence, it was revealed that teachers in both samples are likely to set up objectives focusing on the beginning and end of their hands on activities. This tendency becomes more obvious when teachers perceived needs are observed in Table 12. Teachers both in Japan and in North Carolina perceive the need for objectives related to the process skills in the next situation to discovering the problem, such as gathering data, inductive thinking, designing the experimentation, and identifying variables. Teachers pay attention to "what to solve", and they perceive the need for paying more attention to "how to solve the problems. In terms of this tendency of teachers, Japan and the United States share a lot in common, and there seem to be no real differences. Teachers in both countries tend to focus on how to get students involved in classroom activities. On the other hand, teachers in both countries struggle to involve students into the process of scientific inquiry.

Research Question 5. What are the identifiable differences, if any, in the self-reported science teaching methods utilized by elementary teachers in Japan and North Carolina

In terms of teaching methods and strategies, teachers in both samples have similar tendencies, although Table 15 indicates one difference in the frequency of teachers' behavior and confidence. In North Carolina, 94.3% of teachers (N=176) perceived a confidence in utilizing school facilities, and this was ranked third highest among six items under the category of teaching methods. In Japan, 47.2 % of teachers (N=458) perceived confidence in utilizing audiovisual equipment, and it was also ranked third among six items under the category of teaching methods and strategies. In terms of objectives and teaching methods, drastic differences between the two samples of teachers were not seen in this study.

Limitation of this study

This study is based on the self-reports of teachers' perception of their academic backgrounds and teaching activities. This method of measurement does not always provide the exact information of the actual status of teacher education systems and teachers' classroom activities in Japan and North Carolina.

There are some wording problems in the questionnaires, because this questionnaire was developed by non-native English speakers.

Conclusion based on the results

In terms of the teachers' perceptions of classroom practices such as the objectives and teaching methods they use, American and Japanese teachers are not very different. Both of them perceived frequent use of the objectives which involves finding the problem. According to the data of teachers perception, it is assumed that they do not, but would like to use the objectives concerning the methods of the inquiry process. With regard to their teaching methods and strategies, teachers in both samples use varied teaching strategies and equipment in their schools. Teachers in Japan and North Carolina perceived needs for utilizing facilities outside of schools and for using computers in the classroom.

In terms of the education which they have received, some differences were found in this study. First, elementary teachers in North Carolina are more confident in having a broader view of education in comparison to Japanese elementary teachers. Finally, teachers in North Carolina perceived the needs for academic and professional activities as contrasted with Japanese teachers who perceived the needs for activities closely related to their class and classroom environment.

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APPENDIX A

Draft questionnaire

Appendix 2

A Seminar on the Cooperative Study of
American and Japanese Science Teacher Education

The East-West Center, University of Hawaii
and
Kaimana Beach Hotel
Honolulu, Hawaii
January 15-19, 1990

PRE- AND IN-SERVICE TRAINING PROGRAM OF SCIENCE TEACHERS

Draft Questionnaire

Shigekazu Takemura
Virgilio Manzano
Genzo Nakayama
Celia Balbin
Science Education Department
Hiroshima University Faculty of Education
Japan

CONTENTS

A. OBJECTIVES	Experience: Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Value: Most Important 3	Important 2	Least Important 1
1. I always give a child the chance to be intrigued by objects and events in his environment and be curious about his surroundings.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. I always allow children to sense and formulate the existence of a problem.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. I encourage children to be aware of and respond in a positive manner to beauty and orderliness in his environment.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. I encourage children to be free from bias, prejudice and superstitions, and to acquire other values such as open-mindedness, critical-mindedness, and intellectual honesty.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. I allow children to use habitually, rational and creative thinking abilities when attempting to explain discrepant events, and point out contradictions among seemingly unrelated phenomena.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of the data at hand.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. I allow pupils to acquire critical and questioning attitude toward unsupported inferences and hypotheses. (Belief in cause and effect.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. I encourage pupils to acquire willingness to change beliefs when evidence is found. (Objectivity)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. I encourage pupils to always test hypothesis in a rational manner.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Val		
	Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Most Important 3	Important 2	Least Important 1
10. I allow pupils to appreciate the interrelatedness of science, technology, and society.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11. I encourage pupils to recognize the limitations of scientific modes of inquiry, and their awareness for need of different approaches as affected by economic, psychological, or religious factors in any proposed solutions.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. I encourage pupils to acquire the ability to observe things and events in order to perceive and identify them.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. I encourage pupils to acquire the ability to recall previous experiences and knowledge and to be able to compare facts and memory images.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14. I encourage pupils to acquire the ability to sort out for classification and formulate tentative inferences and hypothesis to identify and explain natural phenomena.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15. I encourage pupils to acquire the ability to recall the proper experiences and generate relevant data to verify tentative if-then statement and suggest procedure for testing it experimentally.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16. I encourage pupils to acquire the ability to gather descriptive and quantitative information needed for developing or testing hypothesis.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17. I encourage pupils to acquire the ability to choose variables in the system which seem most relevant to the problems.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Some times 3	Sel dom 2	Never 1	Most Impor tant 3	Impor tant 2	Least Impor tant 1
18. I encourage pupils to have plenty of chance to design and construct laboratory experiments and apparatus to obtain data to verify hypothesis, and select suitable materials, equipment, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
19. I encourage pupils to handle apparatus in a skillful manner according to prescribed safety rules through controlling and manipulating identified variables.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
20 I encourage pupils to record observations accurately, and organize data, tabulate measures, in precise quantities and use precise language in recording experimental results.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
21. I encourage pupils to identify the variables that materially influence given interactions in a system and formulate the critical model for explanation.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
22. I encourage pupils to demonstrate knowledge of facts, conventions, sequences, classifications, criteria, and draw the knowledge of concepts, laws and principles.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
23. I encourage pupils to apply generalizations to specific cases and to develop further investigations in daily life technology and society.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
24. I encourage pupils to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study, process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his readers or listeners.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Most Important 3	Important 2	Least Important 1
B. ACADEMIC BACKGROUND								
25. I have sufficient preservice background equivalent to a major (or minor) in earth science, biology, chemistry, or physics education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
26. I have acquired inservice training equivalent to a preservice major (or minor) in earth science, biology, chemistry, or physics education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
27. I possess sufficient background in areas of science education other than my area of specialization.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
28. I have sufficient background in the mathematics required/applicable to the science course I teach.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
29. I have studied the historical development and philosophy of science, including the continuing contributions of scientists to modern world.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
30. I am aware of the impact of science and technology to society, as well as of the social responsibilities of scientists.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
31. I possess sufficient background in nonscience fields such as the humanities, social sciences, languages, and philosophy, to enable me to provide a wider perspective and relevance to my science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
32. I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
33. I possess knowledge and understanding of the philosophical, historical, and social purposes of education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Some-times 3	Sel-dom 2	Never 1	Most Impor-tant 3	Impor-tant 2	Least Impor tant 1
34. I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
35. I am abreast with student career opportunities in science.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

C. TEACHING CONTENTS

36. I recognize that teaching content must be consistent with the nature of the learner selected in terms of need and interest, growth levels, patterns of the affective, cognitive and psychomotor domains, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
37. I believe that teaching content must consider the natural and social environment needs of the learner.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
38. I include the nature and need of science and technology in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
39. I recognize the importance of delivery systems selected in terms of children's as well as teachers' instructional difficulties.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
40. I organize contents in large areas or units each of which represents a major program of inquiry or aspect of environment.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
41. I organize areas/content to promote scientific thinking, fundamental understanding, growth in instrumental and problem solving skills needed for inquiry and development of attitude and interest.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
42. I organize content to provide abundant opportunities for building and applying scientific concepts and principles.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience: Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Value: Most Important 3	Important 2	Least Important 1
43. I organize content to provide spiralling and enlarging patterns of growth in concepts, principiles, thinking, manipulating ability and attitude.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
44. I organize content to provide opportunity for children to participate in planning, and implement, evaluate activity in individual and group projects.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
45. I organize content to allow students to view the development of the productive potential of society as related to full utilization of natural and human resources.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
46. I recognize that the purpose of learning content is to meet and organize the deepest needs of human nature, which manifests itself as the desire for beauty of nature and scientific truth.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
D. LESSON PLAN								
47. I prepare lesson plans that cultivate process of science to enable children to acquire the desire to know, question, search for data and meaning, demand verifications, etc.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
48. I construct lesson plans to facilitate process skills such as observing, describing, measuring, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
49. I construct lesson plans that include products of science and culture such as facts, information, phenomena, structures, etc., and their interrelations.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Some-times 3	Sel-dom 2	Never 1	Most Impor-tant 3	Impor-tant 2	Least Impor tant 1
50. I construct lesson plans to promote harmonious activities related to teaching, such as demonstrations, questioning, suggesting, admiring, etc., as well as learning, such as forming various types of experiences, critical investigations, summarizing and evaluating learning, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
51. I construct lesson plans that promote intellectual and creative development among children taking into account levels of readiness, achievement, deficiencies, status of cognitive development, interests, etc .	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
F. TEACHING METHODS AND STRATEGIES								
52 I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
53. I utilize various teaching facilities such as laboratory, classroom, and school grounds in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
54. I utilize various teaching facilities available in the community such as science centers, museums, and natural areas in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
55. I make use of audiovisual devices and materials for teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
56. I make use of a computer to teach selected science topics.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
57. I employ simulation techniques in teaching science topics.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Most Important 3	Important 2	Least Important 1
F. MANAGEMENT OF SCIENCE ROOM/LABORATORY								
58. I device experiments conducted in such as way as to make children think and be conscious of the purpose of performing the experiment.								
59. I allow children to suggest experiments and observations to answer their own questions.								
60. I encourage and guide children to perform experiments carefully and exactly.								
61. I provide opportunities for pupils to learn the value of controlled experimentations.								
62. I apply classroom management techniques to allow for individual, small-group, and whole-class instruction.								
63. I possess laboratory skills such as contructing science laboratory equipment, using and caring for laboratory equipment and materials, and preparing setups for science experiments.								
64. I implement safe laboratory measures.								
65. I am prepared to handle emergencies that may arise.								
66. I employ an order, storage, anu retrieval system in the laboratory.								
G. TEACHING MATERIALS PRODUCTION								
67. I develop instructional materials suited to student ability levels and relevant to classroom objectives.								
68. I adapt and utilize a variety of instructional materials and media such as films, OHP transparencies, software, etc.								

	Experience					Value		
	Very Often 5	Often 4	Some times 3	Sel-dom 2	Never 1	Most Impor-tant 3	Impor tant 2	Least Impor tant 1
69. I select, adapt, and utilize science software for use in teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
70. I develop microcomputer based science lessons for my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
71. I initiate student participation in materials design and production.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

H. EVALUATION OF STUDENTS' LEARNING

72. I believe that a teacher must be well equipped with evaluation designs such as evaluation policy, assumptions, method of data collection and analysis, discrimination of information, cost benefit analysis, product assessment, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
73. I develop and improve for my science class competency tests and evaluation instruments to measure cognitive, process skills, and attitudes.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
74. I utilize fair and varied student evaluation measures such as paper-and pencil tests, essay tests, checklists, interviews, etc..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
75. I utilize results of diagnostic and evaluation procedures in planning instruction.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
76. I assign individual work appropriate to the level of student ability and give feedback/evaluation promptly.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
77. I am able to identify students with special needs and inclinations, and provide the necessary support system or refer them to appropriate persons or agencies for assistance and guidance.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
78. I use a computer to undertake or process evaluation of student learning abilities.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Most Important 3	Important 2	Least Important 1
79. I construct and use a science test item data bank.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
I. TEACHER'S OPPORTUNITY FOR TRAINING								
80. My school regularly provides and supports various venues for inservice training.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
81. Within the past three years, I have undergone updating in my specialized area (earth science, biology, chemistry, or physics education).	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
82. Within the past three years, I have attended meetings, conventions, seminars, or conferences related to science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
83. Within the past three years, I have attended short courses, summer institutes, or similar trainings for science teachers.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
84. Within the past three years, I have undergone training/updating on new instructional methods and strategies for science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
85. Within the past three years, I have undergone training/updating on the development and production of conventional/innovative science curriculum materials.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
86. Within the past three years, I have undergone training/updating on laboratory techniques, procedures, and safety.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
87. Within the past three years, I have undergone training/updating on developments in student evaluation techniques.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
88. Within the past three years, I have undergone training/updating on the organization and management of science classes.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Sometimes 3	Seldom 2	Never 1	Most Important 3	Important 2	Least Important 1
89. Within the past three years, I have attended graduate school courses offered by an advanced degree-granting institution.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
J. TEACHER'S AUTONOMY IN ACQUIRING KNOWLEDGE AND SKILLS IN TEACHING								
90. I am abreast with ongoing curriculum projects and related developments in my teaching field	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
91. I am a member of a local or national association of science teachers.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
92. I regularly read journals and other publications concerned with science teaching, scientific developments, and science related issues.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
93. I make effort to contact professionals and organizations (local, national, international) in my field to provide enrichment to my teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
94. I extend my knowledge and understanding of students and their environment thru constant visitations and contacts with individuals and organizations in the community.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
95. Within the past three years, I have submitted at least one article or other manuscript related to science teaching for publication in a professional journal or other publications.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
96. Within the past three years, I have participated in educational projects (curriculum research study, development of innovative curriculum materials, etc.).	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
97. I always strive to give my best when I teach and prepare for my science class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
98. I motivate my students to learn science.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very Often 5	Often 4	Some-times 3	Sel-dom 2	Never 1	Most Impor-tant 3	Impor-tant 2	Least Impor-tant 1
99. I am proud of being a science teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
100. Beauty, purity, and goodness are indispensable virtues of a teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
101. A clear sense of justice and sincerity are qualities that a teacher must possess.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
102. Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human beings and education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
103. A true teacher knows how to establish cooperation and maintain harmonious relationships with others in the school and in the community.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
104. Inquisitiveness, open-mindedness, generosity, and a well-directed sense of aggressiveness are necessary traits of a science teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
105. Leadership is an invaluable quality of a science teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
106. I believe that everyone in a group deserves equal respect, attention and opportunity.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
107. A teacher must be kind in her/his dealings with everyone in the school and in the community, and show concern for the weak and the unfortunate.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
108. At all times, a teacher is a model in caring for public properties, and in ensuring protection of public morals.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

APPENDIX B

Questionnaire used in North Carolina

QUESTIONNAIRE ON TEACHER AUTONOMY AND THEIR IN-SERVICE TRAINING

Developed by

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Teaching Grade.______ Name____________________________

Please read through each of the following sentences and indicate in the box under "Experi how frequently you have been doing using the following key:

5 = Very often   4 = Often   3 = Sometimes   2 = Seldom   1 = Never

and, please indicate the impotance of each sentece in the box under the "Value" using following key:how important you think what sentence says is.

3 = High value   2 = Intermidiate value   1 = Low Value

Please indicate your answer by checking appropriate box.

Example;

	Experience					Value		
	Very often	often	Some- times	Sel dom	Never	High value	Inter- midiate value	Low value
1. I take student on field trip.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

This means I <u>do</u> take student on field trip <u>very often</u> but I <u>don't think</u> it is <u>important</u> to take student to field trip.

I will appreciate your cooperation.

	Experience					Value		
	Very often 5	often 4	Some- times 3	Sel dom 2	Never 1	High value 3	Inter- midiate value 2	Low value 1
A. Objectives								
1. I always give children the chance to be intrigued by objects and events in his environment.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. I always allow children to sense and formulate the existence of problem.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. I encourage children to be aware of and respond in a positive manner to beauty and organization in his environment.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. I allow children to use habitually, rational and creative thinking abilities when attempting to explain discrepant events, and point out contradictions among seemingly unrelated phenomena.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. I encourage children to show willingness to expose their tentative ideas and explanations to others and reconsider their thinking in light of data at hand	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
6. I allow children to have a critical and questioning attitude toward unsupported inferences and hypotheses. (Belief in cause and effect)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. I encourage children to always test hypothesis in a rational manner.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. I allow children to appreciate the interrelatedness of science, technology, and society.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. I encourage children to recognize the limitations of scientific modes of inquiry, and their awareness for need of different approaches as affected by economic, psychological, or religious factors in any proposed solutions.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
10. I encourage children to acquire the ability to observe things and events in order to perceive and identify them.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
11. I encourage children to acquire the ability to sort out for classification and formulate tentative inferences and hypoth-esis to identify and explain natural phenomena.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. I encourage children to acquire the ability to recall the proper experiences and generate relevant data to verify tentative if-then statement and suggest procedure for testing it experimentally.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. I encourage children to acquire the ability to gather descriptive and quanti-tative information needed for developing or testing hypothesis.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14. I allow children to have plenty of chance to design and construct labora-tory experiments and apparatus, in order to obtain data, verify hypothesis, and select suitable materials, equipment, etc...	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15. I encourage children to identify the variables that materially influence given instructions in a system and formulate the critical model for explanation.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
16. I encourage children to demonstrate knowledge of facts, conventions, sequences classifications, criteria, and draw on the knowledge of concepts, laws and principles for use in classroom and in their environment..	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17. I encourage children to apply generalizations to specific cases and to develop further investigations in daily life technology and society.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
18. I encourage children to communicate scientific information and findings to others, orally and in writing, by means of describing the purpose of study process of inquiry, conclusions, applications, etc. in words that facilitate understanding in his readers or listeners.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

B. Academic Background

	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
1. I have sufficient pre-service background equivalent to a major (or minor) in each science, biology, chemistry, of physics education	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
2. I have acquired in-service training that are similar to my pre-service major (or minor) in each science, biology, chemistry, of physics education	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. I possess sufficient background in area of science education other than my area of specialization.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. I have sufficient background in the mathematics required/applicable to the science course I teach.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. I have studied the historical development and philosophy of science, including the continuing contributions of scientists to modern world.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. I possess sufficient background in non-science fields such as the humanities, social sciences, languages, and philosophy, to enable me to provide a wider perspective and relevance to my science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
7. I possess sufficient background in psychology to enable me to understand the physical, emotional, and intellectual development of my students	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. I possess knowledge and understanding of the philosophical, historical and social purpose of education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. I possess both background and enrichment in curriculum development techniques such as content sequencing, concept development, and writing of instructional objectives.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

C. Teaching Method and Strategy

	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
1. I utilize various teaching strategies such as inquiry, case studies, and demonstration in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. I utilize various teaching facilities such as laboratory, classroom, and school grounds in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
3. I utilize various facilities available in the community such as science centers, museums, and natural areas in my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. I make use of audiovisual devices and materials for teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. I make use of a computer to teach selected science topics.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. I use various kinds of evaluation instruments to measure cognitive, process skills, and attitudes	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

D. Teacher's Opportunity for Training

1. Within the past three years, I have updated my knowledge in my specialized area.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. Within the past three years, I have attended meetings, conventions, seminars, or conferences related to science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some- times 3	Sel dom 2	Never 1	High value 3	Inter- midiate value 2	Low value 1
3. Within the past three years, I have attended short courses, summer institutes, or similar trainings for science teachers.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4. Within the past three years, I have updated my knowledge on new instructional methods and strategies for science teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. Within the past three years, I have updated my knowledge on the development and production of conventional/innovative science curriculum materials.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. Within the past three years, I have updated my knowledge on laboratory techniques, procedures and safety.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. Within the past three years, I have updated my knowledge on developments in student evaluation techniques.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. Within the past three years, I have updated my knowledge on the organization and management of science classes.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
9. Within the past three years, I have attended graduate school courses offered by an advanced degree-granting institution.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

E. Teachers Autonomy in Acquiring Knowledge and Skills in Teaching

1. I am abreast with on going curriculum projects and related developments in my teaching field.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2. I regularly read journals and other pub lications concerned with science teaching, scientific developments, and science related issue.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3. I make effort to contact professionals and organizations (local, national, inter-national) in my field to provide enrichment to my teaching.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some- times 3	Sel dom 2	Never 1	High value 3	Inter- midiate value 2	Low value 1
4. I extend my knowledge and understand ing of students and their environment thru constant visitations and contacts with individuals and organizations in the community.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5. Within the past three years, I have submitted at least one article or other manuscript related to science teaching for publication in a professional journal or other publications.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6. Within the past three years, I have participated in educational projects (curriculum research study, development of innovative curriculum materials, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7. I always strive to give my best when I teach and prepare for my science class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8. I am proud of being a science teacher	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9. Inside and outside teaching activities, a teacher must always demonstrate and give authentic witnessing to love for children, human being and education.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

	Experience					Value		
	Very often 5	often 4	Some-times 3	Sel dom 2	Never 1	High value 3	Inter-midiate value 2	Low value 1
10. I knows how to establish cooperation and maintain harmonious relationships with others in the school and in the community	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11. Inquisitiveness, open-mindedness, generosity, and a well-directed sense of aggres siveness are necessary traits of a science teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12. Leadership is an invaluable quality of a science teacher.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13. I have developed instructional materials suited to student ability levels and relevant to classroom objectives	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14 I have developed microcomputer based science lessons for my class.	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

With regard to next one question please answer "Yes" or "No".

15. I am a member of state or national organization of science teachers. Yes [ ] No [ ]

Please send this back to

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I appreciate your cooperation.