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How Are the Novice Getting to Be the Expert? : A Preliminary Case Study on Japanese Science Teachers

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ABSTRACT

Most of comparative studies in science teacher education so far have been conducted in terms of teacher education policy, pre- and in-service training system and curriculum, and certificate system. While such superficial information can be readily obtainable, it does not necessarily enable us to make access to reality of science teachers' professional development in respective countries, because practice in professional development among science teachers is deeply embedded into respective socio-cultural environment or climate. In order to get information on reality in science teachers' professional development, alternative approaches of research should be developed. This paper aims at pursuing an alternative way to approach reality of Japanese science teachers' professional development. An email survey of free description method with 29 in-service science teachers with a variety of years of experience in Ibaraki Prefecture, Japan, revealed that Japanese science teachers have developed their expertise through very close daily-based communication with their peer science teachers. At least, within their consciousness, neither formal in-service training programs, nor pre-service training programs have had much stronger effects on their professional development than such non-formal, daily-based, deep, apprenticeship-typed or in some sense, family-typed communication. The results suggest that in order to conduct meaningful comparative studies, we should take much more attention to how to make access to reality of science teachers' professional development.

Key words: Japan, science teacher, novice, expert

Ⅰ. Introduction

Teacher education in Japanese contexts has been well documented in various references (Shimahara, 1991; Shimahara, 1998; Lamie, 1998; Takakura and Murata, 1998; Okano and Tsuchiya, 1999). Sato and Asanuma (2000) describe the main features of the system of teacher education and to analyze the key issues that affect it. In the section 'the current system of teacher education' they show their own view on teacher certification system, teacher education policies, and in-service teacher education. Science teacher education in Japan is, for example,

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also described by Ogawa (1998) and Ogawa (2001). Brief summary of such description of Japanese teacher education in general and science teacher education in particular is shown in Appendix 1.

However, this kind of description seems to give us little information on 'reality' of how teachers develop their own expertise. Perfect 'system' does not necessarily mean the system works 'perfectly' in practice. For example, Japanese head science teachers realize that non-formal ways like communication with peer teachers, information from professional books and journals, and information from TV and newspapers, are much more important ways for science teachers to cultivate their expertise than formal pre-service or in-service teacher education programs (Ogura and Hatogai, 2001). Since the goal of teacher education is to make teachers 'real professionals' in teaching, comparative studies should take much more attention to how their expertise be cultivated in their own 'real' professional life. In this sense, a simple comparison among formal teacher education systems alone does not work well enough to show certain implications.

Thus, we should look for another kind of research perspective, which compensates information on system or institution level, before conducting comparative studies in teacher education. For example, Collinson and Ono (2001) argue the professional development of teachers in the US and Japan from an interesting viewpoint. They compare teachers' professional development in the two countries by describing the situations, 'beginning teachers' first year', and 'career-long professional development for teachers.' This treatment successfully uncovers characteristics of teacher as a profession in the two countries. And, Kinney (1998) conducts interview research on Japanese teachers in 1995 for two months. Her description making strong focus on teachers' daily life and teaching profession in real school settings is very extensive, well documented and contains a fruitful information on how Japanese teachers live in their working environment. Such kinds of approach may be much more promising when we want to describe how teachers develop their expertise in their real school settings than the usual approach, for example, comparing formal systems of professional development of teachers in several countries.

One of the best studies on the processes of professional development of Japanese teachers is of Inagaki et al. (1988). In 1984, they conducted a survey research with in depth interview on a cohort of alumni graduating at Nagano normal school in 1931 and spending their whole professional lives (about 40 years) as elementary and secondary school teachers. One of the primary purposes of the study was to find out how their expertise had been cultivated during their professional lives. While they spent 'Pre-War time', 'War time' and 'Post-War time' as teachers, and experienced drastic systematic change in education system as well as social system after the World War II, their patterns of professional development were quite similar to those of teachers growing up after democratization of Japan. This means that the ethos of teaching professionals has been still alive for over 70 years. Among their findings are as follows: (1) professional skills and expertise of teachers have been cultivated through their whole life in real school settings, neither through formal pre-service nor in-service teacher training programs. (2)

Thus, formal pre-service teacher training programs, though necessary for obtaining teacher certificates, had been few significant effects on prospective teachers' professional development. (3) In-service teacher training programs, either, had not worked well on practicing teachers' professional development. (4) Instead, daily communication (both within school settings and out of school settings) with experienced peer teachers in their own school or in the schools near-by, despite they were senior or not, had been one of the most powerful influences to teachers' professional development. (5) Among the school settings were daily conversations at the teachers' room, various types of teacher meetings, in- school conferences, class inspections, and faculty meetings. As a whole, teachers had been sharing an ethos of teachers and a common cultural climate where peer teachers develop their own expertise through mutual learning among them. A novice teacher assigned to a certain school is welcomed as one of the peers of the school but never expected to serve as an expert of teaching in his/her beginning days. He/she has been encouraged, supported, and taught by his/her peer teachers for several years. Through this 'initiation' process, he/she can gradually develop his/her professional skills and way of thinking and of doing.

If this type of research reflects on reality of how Japanese teachers had developed their expertise, there is no reason to reject such research methodology as a tool for future comparative studies among relevant countries. Thus, this study is a small scaled trial to examine whether or not such kind of research methodology is useful to make access to reality of professional development of recent science teachers in Japan.

Ⅱ. Purpose of the Study

The research questions of the survey are: (1) What are the indexes of the expertise as science teacher? (2) What are the major factors affecting science teachers' development of their expertise? (3) What is the major advice of expert science teachers for the novice to be the expert? And (4) Do the formal teacher training programs still not work powerfully?

Ⅲ. Methods

The survey was administered in the form of email interview. The sample consisted of the science teaching major graduates of science teacher training programs in Faculty of Education, Ibaraki University, one of national universities. They were mentored or supervised by the present author during their days in their respective programs. Among total 52 graduates who have been practicing science teachers, those whose email addresses were available through the address list of the alumni were selected as the sample of the study. Interview format (see Appendix 2) was sent to total 33 in-service science teachers with different teaching experience (from 21 to 4 years). Novice teachers (less than 3 years' experience) were omitted from the subject because they seemed to be not yet serving as 'expert science teacher'. Among 33, 4 emails returned

unsuccessfully because of their email addresses might be changed. Thus, 16 among 29 in-service science teachers were willing to join the survey and successfully returned me back their responses. These responses were the primary source of the study. Distribution of the respondent's profile is shown in Table 1.

Table 1. Distribution of the respondents' profile

	Years of experience
Male	21, 20, 20, 17, 17, 16, 16, 15, 13, 7, 4
Female	15, 14, 13, 8, 5

Ⅳ. Results

1. Specific Occasion in realizing themselves to become 'well-prepared' science teacher

I realized 'well-prepared' in my seventh year because just the year before I had experience to teach every grader's science classes. But, even now, I have a little bit of uneasy feeling on saying I am 'well-prepared'. Of course, I do not want to be a perfect science teacher, but in the occasion of teaching science classes with little experience I still feel at a loss. (Male, 20 years' experience)

In my case, I started science teaching in 7th grader, and then, 8th and 9th in my lower-secondary. So, at this time of point, I had an experience to teach every grader's science classes at lower-secondary. Thus, I realized 'well-prepared'. (Male, 16 years' experience)

Five years... One year as a newly recruited science teacher, and during next four years I taught every grader's science classes at my upper- secondary school. (Male, 15 years' experience)

Fourth years after my first teaching of science classes, because just before three years I taught every grader's science classes in lower- secondary. (Female, 15 years' experience)

The responses to the question when they realize themselves to become 'well-prepared' science teacher vary. But generally, science teachers with long experience answered longer term needed to become 'well-prepared' than those with short experience. It seems that experienced science teachers realize 'well-preparedness' much higher level than those with less experience. Science teacher in his/her early career once realizes he/she has become 'well-prepared', but with the year

of experience, the criteria on 'well-preparedness' seems to be getting higher and he/she comes to realize to be in the process of developing expertise.

Among the common responses to specific occasion when they realize themselves to become 'well-prepared' science teacher, are 1) when he/she had taught every grader's science classes, and 2) when he/she could serve as head science teacher of the school concerned. Japanese schools have science lab classrooms. While head science teacher has responsibility for the science classes in the school working well, another major work is to maintain science lab classrooms as be ready for use by any other teachers. Among the concrete jobs are 1) management and maintenance of relevant chemicals, equipments, and apparatuses, 2) maintenance of outdoor facilities like school garden and school pond. Unfortunately, in the pre-service science teacher training program, there is little chance to learn about how head science teacher does his/her work, even if certain knowledge on this can be taught in a lecture style.

> *I felt 'well-prepared' in my third year, because I was appointed as head science teacher at that school and did various things like maintaining chemicals and lab classrooms, and preparing a list of equipments and apparatuses in the lab classrooms. (Female, 14 years' experience)*

This case needs background information. She has been serving as an elementary school teacher during her early days. In elementary schools, there are a few science teachers. The ratio of science teacher pre elementary school is about 1.17 with about 290 pupils per science teacher (Ogawa 2001, p.599). Thus, even if he/she is a teacher with a little experience he/she has been appointed as head science teacher in elementary schools. Similar situation can be seen in the response as:

> *I felt 'well-prepared' when I could serve as head science teacher or when I could make advice on science teaching to other non-science teachers. I served as head science teacher in my second year. (Female, 5 years' experience)*

There are also responses to mention that they felt 'well-prepared' when I was asked various kinds of questions and advice on science teaching from other non-science teachers.

2. Most effective ways to develop expertise

They identified several ways to develop their own expertise. Among them major ways are (1) communication with peer teachers, (2) observing others' science classes, (3) science lab classroom management, (4) serving as head science teacher, and (5) reading professional journals and books. There are few responses indicating formal in-service teacher education programs and activities of regional science teacher circles.

Most responses indicated close communication with peer teachers. There are two types of communication mode. One is advice from more experienced teachers, and the other is to give advice to novice or less experienced teachers. Examples of the former are as follows:

> I was so lucky because several science teachers there and they were so kind as to teach me various kinds of things needed to serve as science teacher. And, I could ask anything whenever I wanted to do. (Female, 13 years' experience)

> Exchange ideas and information from much more experienced science teachers within my school were very much helpful. (Male, 17 years' experience)

> Advice from a certain experienced science teacher was the best. In my case, I had been very much influenced by the teacher, not only in teaching science but also in student guidance activities as a classroom teacher. (Male, 4 years' experience)

One of the examples of the latter type is shown below:

> *I had experiences to serving as mentor of novice teachers in my third and fifth year, respectively. These were very good occasions for me to reflect myself as a science teacher. I felt the same feeling when I supervised a pre-service science teacher in his student teaching. (Male, 13 years' experience)*

Close communication among peer teachers is one of the major reson why teachers readily accept other teachers' visitation to or observation of their own classes.

> *I had a respectable experienced teacher at my first school, and he allowed me to drop in his science class whenever I wanted. (Male, 20 years' experience)*

> *At the time to observe other teachers' classes, I could realize other ways of teaching which I had not yet known. (Male, 16 years' experience)*

One more point should be reminded. Teachers visiting or observing a class in order to make comments to the teacher teaching the class also believe that such occasion is even worth helping cultivate their own expertise, too. They believe that teaching somebody is also a key factor to cultivate their own expertise.

Some teachers referred to 'science lab classroom management', and 'serving as head science teacher' as one of the effective ways to cultivate expertise.

> *I had been transferred to newly built schools twice in my professional life. At these*

schools there is nothing in science lab classrooms. And I had to buy various kinds of chemicals, equipments, apparatuses, and consumables, and construct a learning environment. While this job was very heavy for me, I had learned a lot from the processes, I feel right now. (Male, 20 years' experience)

I had few ideas on science lab classroom management when I first served as head science teacher. And I bought manual books on how to manage chemicals in science lab, and on how to manage science lab classroom. (Male, 16 years' experience)

I served as head science teacher in my second year, because I was only one science teacher at the school at that time. This occasion was, I realize now, very much fruitful. (Female, 5 years' experience)

As already mentioned, science lab classroom management is not so deeply treated in pre-service science teacher training programs generally. In this sense, most of the novice science teachers have little ideas on this point. However, since lab classroom management is one of the important jobs for science teachers, novice teachers are apt to be so nervous and worried about it. The results of science lab classroom management were easily detectable by others. Thus, science teachers tend to be much keener about science lab classroom management than teaching practice.

Reading professional journals and books is a rare case to be identified as 'effective'. Generally, recent practicing science teachers do not buy many professional books and journals. Rather, they can obtain needed information from internet resources (for example, mailing lists among practicing teachers, web-based databases etc.).

Only one upper-secondary science teacher referred to a certain science teacher's circle as effective.

In my case, a research circle among practicing upper secondary science teachers had been a wonderful resource for information on teaching science. Within that circle, I realized that I could cultivate my expertise through attending to annual conferences on science teaching. (Male, 21 years' experience)

In summary, most of science teachers had positive affects from close communication among peer teachers, and from observation of other teachers' science classes.

3. Most effective ways to help novice teachers develop their expertise

Science teachers recommended novice teachers to visit and observe a lot of science classes his/her senior peer science teachers teach and 'thieve' their teaching skills, management skills,

and communication skills.

> *I recommend novice teachers to observe my daily science classes, not a science class for special teaching conference. And also, I would ask them to open their respective science classes to other peer science teachers. Discussion on the classes in daily basis is very much helpful for them to develop their professional skills. (Male, 20 years' experience)*

Two science teachers suggested that senior science teachers should talk about their own 'failed' stories. They said that such stories seem to make novice teachers feel relaxed. A 4 years' experience science teacher mentioned as follows:

> *It may be very helpful if there is a family-like atmosphere and 'frankly-speaking network' among peer teachers in the school concerned. Under such situation, novice teachers can readily hear a lot of failed (not succeeded) stories among peer science teachers.*

A 20 years' experienced male science teacher said that:

Close communication with novice teachers, praising them, and learning with them.

An interesting point relevant to this question is that the close communication did not restricted within school setting but were extended to 'after school settings'. Some of the senior teachers sometimes invited novice or younger teachers to a kind of pub and continued their discussion on science teaching with drinking beer or sake until at the late night. This 'family-like' communication among teachers might be one of the important factors affecting teachers' expertise cultivation.

Other things science teachers also referred to are (1) teaching time management, (2) safety management in science lab classes, (3) developing teaching materials, and (4) developing yearly plan, and so on.

4. Most effective ways to continue to develop expertise as science teacher

To this question there are also many suggestions relative to communication with peer science teachers. Among them are:

> *Observing other teacher's science classes one another and imitating other teacher's practices which you think are good. (Male, 20 years' experience)*

Receiving senior peer science teachers' advice. (Male, 17 years' experience)

Inviting senior peer teachers to your science classes and discussing on your classes with them. (Male, 16 years' experience)

Other major responses are (1) serving as head science teacher, (2) always keeping in mind to look for materials suitable for science classes, (3) attending science festivals, (4) visiting science museums and science centers, and (5) learning in graduate programs. An interesting recommendation is 'to check students' notebooks for reflecting your science teaching' (Male, 16 years' experience). There is still little awareness among science teachers that students' notebooks are very good resource for self-reflection on science classes.

One teacher referred to research circle among science teachers.

I recommend that you can join a regional research circle on science teachers. It can help you receive various kinds of relevant information on science teaching. (Male, 21 years' experience)

Internet is regarded as one of the promising communication modes among science teachers. They said there are several mailing lists on science teaching and discussion and information exchange through the lists are very helpful for their development of expertise. Of course, internet can serve as one of the important data bank of relevant information and prospective teaching materials. However, science teachers have not yet been serious concern about correctness or validity of such information.

5. Effects of regional science teachers' professional activities on their development of expertise

Interesting enough, most science teachers realized few effects of activities by regional science teacher associations on professional development. They regarded such activities have turned out to be 'formalized' or 'hollow'.

Such activities are, in fact, no meaning for us in terms of cultivating expertise, though they serve as a kind of 'social gathering'. (Female, 13 years' experience)

There are certain kinds of obligation, limitation, and restriction in such associations and circles. Thus, I do not think they can make positive effects on teachers' professional development. Actually, such activities come to be compulsory. (Male, 16 years' experience)

Activities of regional association of science teachers in my area have been so much formalized. Every year, some teachers make a series of oral presentations on their own teaching practices, and after that all the attendees visit a certain scientific research institute. I think such activities have no effects on our developing expertise. Rather, I would prefer to do my own research on science teaching practice by myself. (Male, 20 years' experience)

Among other comments relevant to this point are (1) teachers are too busy to attend such activities, (2) no interests on such activities, (3) I don't like it because such activities seem to be authoritarian, and (4) rationale or philosophy of the association is different from mine. In summary, science teachers possess negative sympathy or feelings toward regional science teachers associations or research circles.

Ⅴ. Discussion

The primary purpose of this preliminary study was to examine what are the major factors contributing to science teachers' expertise development. For that purpose, a survey was administered, where several questions were involved: (1) What are the indexes of the expertise as science teacher? (2) What are the major factors affecting science teachers' development of their expertise? (3) What is the major advice of expert science teachers for the novice to be the expert? and (4) Do the formal teacher training programs still not work powerfully? The respective questions gave light to different facets of professional development of science teachers. While science teachers responded differentially to each question, some common features among their responses came about.

1. Teachers should continue to develop their own expertise through their professional life

Among Japanese science teachers as well as teachers in general, there is a hidden consensus that teacher is a profession whose expertise should continue to be cultivated through his/her professional life. It is a kind of norm, which has been a long history since modern education system was introduced in mid 19th century. Teacher was believed to be a profession with a 'holy' mission to help children develop. Teacher in its early era was regarded to be 'intelligentsia' or one of the centers of knowledge and wisdom in community. Such atmosphere among community has forced teachers to be in a higher level of ethics, morality and a sense of mission. Thus, they have kept in mind to become much better teacher, not only in his/her professional skills but also in his/her mental development. Within these couple of years, it is said that such sentiment seems to be diminishing especially among younger generation, but I think the norm and moral have been still shared and alive in their minds deeply.

One thing I must add to this is that such continuous cultivation or development of their

expertise is presupposed to be done by their self-effort or self-discipline. It looks like a kind of 'ascetic exercise'. Others can help and support them, but cannot make them 'expert' in a night.

2. Nobody expects pre-service science teacher training programs to cultivate expertise of prospective science teachers

Thus, it is very natural that nobody expects pre-service teacher training programs to cultivate 'perfect' expertise among pre-service teachers, despite of tremendous amount of efforts to revise the criteria of teacher certification and the curriculum standards for pre-service teacher training programs. In science teacher's pre-service programs, there have been many revisions on method courses. For example, there are courses in which in-service expert science teachers are invited to serve as guest lecturer and give a talk on their personal experience. In other courses, science class visit is involved in order to observe 'real' class taught by expert science teachers. However, a novice teacher is still not regarded as an expert in his/her beginning years.

There is a contradiction. While formal teacher certification system presupposes that one who successfully obtains a teacher certificate is qualified and permitted to serve as a 'teacher', nobody expects a novice teacher graduating pre-service teacher training programs and obtaining a relevant certificate to serve as an 'expert teacher'. Japanese society still accepts novice teachers as 'professional' teachers. The issue comes about. Is teacher certificate a minimum standard, or a maximum? Of course, we agree it be a minimum. But, in reality, when discussing on pre-service teacher training programs and teacher certificate system, we sometimes pursue an ideal of 'expert teacher' as the goal of such programs and certificates. A double-standard really works in Japan. We should be much more careful to this point.

3. Formal in-service training programs are out of scope in terms of professional development

One of the most interesting findings from the present survey is that few respondents referred to formal in-service training programs in terms of effective ways for professional development. Science teachers do not realize that such in-service training programs work well in cultivating their expertise. In Japan, teachers are forced to attend formal in-service training programs designed and administered by Prefectural or municipal boards of education when they are in the first year, the fifth year, the tenth year and the twentieth year of their experience (see Appendix 1). Most of the programs consist of (1) lectures by university professors or prominent educators (especially from the MEXT), (2) Discussion classes on specific subject, (3) Practical skill development classes, and in some cases, (4) Case study and presentation of their findings. However, as some respondents mentioned, such in-service training programs are too 'institutionalized' to cultivate expertise. Formalism goes first. The findings of the present survey suggest that even in volunteered regional circles of science teachers once formalization or institutionalization happens, one of the most important functions, that is, mutual cultivation of

their expertise, cannot be achieved within Japanese teachers' cultural climate.

4. Close and dense communication among teachers as a hidden curriculum

Teacher community in Japan has a rather 'closed' atmosphere, which can be called as 'cultural climate'. To the outsiders, teachers behave very politely but never easily accept others to go into the teacher's 'holy' sphere. However, for the insiders the sphere is very comfortable to live in and 'family-like'. So, quite easily communication among peer teachers can happen. Experienced teachers are generally very helpful to younger teachers like sons, daughters, or brothers and sisters.

Behind this type of cultural climate, another factor could be hidden. In most of the rural prefectures in Japan, graduates from a certain normal school (after the World War II, such normal school had involved in a national university system as a Faculty of Education) are dominant. Thus, there exists a very tight alumni linkage among the teachers. For a symbolic example, an experienced teacher asked a novice teacher that who was your supervisor or mentor professor. If she answered Prof. X, he said, 'Oh, Prof. X? Me, too!!' At this time of moment, he accepts her very much as a 'sister' teacher. Very close family-like communication mode among teachers' community, on the one hand, and very close alumni linkage, on the other hand are very key factors why science teachers referred to communication among peer teachers as an important point for their cultivating expertise.

This communication channel seems to serve as one of the best ways to cultivate science teachers' mutual development of expertise. Similar findings are presented by Ogura and Hatogai (2001). Not only in school settings (for example, conversation in the teacher's office room, in the preparation room for science lab, and in science lab classrooms), but also in out-of-school settings (for example, in a senior teacher's home party, and in the pubs and restaurants), science teachers can readily discuss and exchange their ideas on teaching skills, teaching materials, class management, etc personally and frankly. Such occasions are much more powerful way to cultivate their expertise.

However, once the formal faculty meeting or staff meeting with a significant number of teachers is set, it is rather difficult to exchange their personal ideas frankly. Formalization or institutionalization does happen. In contrast, in science teachers' meeting in a certain school, though it is a formal meeting, there seems to be much more relaxed atmosphere. Peer awareness as well as a size effect (meaning at most 4-6 science teachers in a school) seems to work.

Another important factor should not be underestimated. That is a shared ideal that teachers should be ever-cultivating their own expertise during their professional life. To achieve the ideal, each teacher should have a kind of open-mindedness to criticism from other peer teachers. Such comments and suggestions are believed to be a very positive mean for developing his/her expertise. Unless close communication and family-like relationship happens, such kinds of criticism cannot be accepted as a positive motive for the teacher concerned.

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Ⅵ. Concluding Remarks

The present survey reveals that in Japanese science teacher's professional development one of the most important factors to support their expertise development is science teachers' cultural climate and human relationships producing informal, personal, and close communication among themselves, especially in rural areas where most of science teachers are graduates of a science teacher education institute in that region. Once formalization or institutionalization of communication routes happen, it kills this close family-like communication. Formal pre-service and in-service science teacher training programs do not necessarily contribute effectively to science teachers' 'actual' professional development.

The results propose an interesting suggestion on comparative studies on science teacher education in different countries. Unless much information on socio-cultural climate shared with science teachers in respective contexts (whether or not it be a country, a region or a group) is collected, no precise comparison on science teachers' professional development be performed. While differences in formal system of science teacher education are of worth knowing, such information should be compensated with that of teachers' cultural climate if we want to know the differences among target countries and learn their lessons much more precisely.

At least for Japanese science teacher education, we should be much more careful to the real situation where science teachers cultivate their own expertise as professional, qualified science teacher during his/her professional life. Formal science teacher education systems never speak out reality in professional development among Japanese science teachers.

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Appendix 1: Brief Sketch of Japanese Science Teacher Education.

(This description is, in part, based upon Ogawa, 1998 and Ogawa, 2001)

1. Historical Sketch of Teacher Training System in Japan

Before Western Modernization (before 1865), there is no formal education system for commoners, but for Samurai Warriors' schools. For commoners, there are Terakoya schools (private volunteer schools), where volunteer teachers (for example, samurai warriors, priests, or medical doctors) taught them. In Terakoya schools' learning, people came to share Confucian value system, and also be aware of importance of literacy and numeracy. Through such education system, Japanese people's literacy at that time was compatible or better than western people. For example, about 80% of male commoners in Kyoto were literate. Meiji Restoration (1870s') opened the door of western education system into Japan and elementary schools, secondary schools and colleges had established. Also established were normal schools for teacher training school. The government realized emergent needs for high-quality teachers in Japan and established fundamental philosophy of teacher training, in which teachers should be trained at specific schools named normal schools.

2. Characteristics of Contemporary Japanese School Education System

Japanese education system is under the strict control of central government (Ministry of Education, Culture, Sports, Science and Technology: MEXT) by means of specific laws (Fundamental Law of Education, School Education Law, and Enforcement Regulations for School Education Law). Major topics under control are; course of study, textbooks, educational personnel, educational administration, school lunch, school health, and educational finance. Prefectural and municipal boards of education are putting such policies into practice.

3. Fundamental Philosophy of Teacher Education in Japan

One of the most important characteristics considering professional development of teachers in Japan is that teachers realize the necessity of lifelong development and learning in their profession, which can be achieved through mutual learning in the on-the job training basis within teachers' community. Teacher certificate means only an initial ticket to the teaching profession. It is a minimum. Never does it mean the final qualification. Thus, once a newly adopted teacher is assigned to a certain school, he/she has been supported and encouraged by peer teachers of the school concerned.

4. Teacher Certificate System in Japan

Teacher certificate system is under the control of Educational Personnel Certification Law. Teacher training programs of each university are authorized by the MEXT. Credits issued from the university providing teacher training professional courses are automatically authorized by the Prefectural Board of Education as the courses relevant to certificate courses. The Prefecutral Board of Education issues certificates to those who finished successfully teacher training programs. A certificate is valid for his/her whole life all over Japan. Education Personnel Certification Law was revised in 1998 and strong emphasis has laid on cultivation of teachers' capabilities of class management or student counseling, because recently Japanese schools have various kinds of difficulties (bullying, violence, refusal to come to school) and government wants teachers to have capability to do with such difficulties (see Ogawa, 2001). Thus, drastic cut-down of academic content courses has happened. For example, to obtain lower-secondary or upper-secondary science teacher certificates, academic science courses of 40 credit hours were required before the revision, but now only 20 credit hours are required.

5. Pre-service Teacher Training Programs

There are two types of teacher training institutions. One is teacher training universities and colleges, and the other is non-teacher training universities and colleges with teacher training programs. In both cases, every teacher training programs must be authorized the MEXT according to follow Standards for teacher training programs (for example, unit of authorization, courses, teaching staffs, facilities, books and equipments, schools for student teaching, student teaching programs, and inspection) established by the Council for Educational Personnel Training.

6. University Graduation and Teacher Certificates Requirement

Those who want to obtain teacher certificates must fulfill two different requirements: One is for bachelor's degree and the other is for teacher certificates. Table 2 shows one of a typical curriculum standard for school teacher training program in Faculty of Education of a national university.

7. Teacher Adoption in Japan (Takakura and Murata, 1998)

Teacher appointment (adoption, promotion and transfer) is made when a position becomes vacant. Adoption of teachers is conducted not as competitive examination but as selective examination. The screening is done by a combination of a written exam, a practical exam (music, swimming, etc), a physical strength test, an aptitude test, interview, and group discussion or micro-teaching (in the second round). Furthermore, applicant's experience in club activities and social activities are also taken into consideration. Generally, adoption process is

administered once a year and a list of successful candidates is prepared for the case of vacancy.

Table 2a and 2b. Curriculum standard for school teacher training program of faculty of education, Ibaraki University. (Total 125 credit hours)

Curriculum Standard for School Teacher Training Program

Category	Elementary	Lower-Secondary
General Education	26	26
Common Fundamental	10	10
Foreign Languages	6	6
Health & Physical Education	2	2
Computer & Information Skills	2	2
Specific Topics	14-	14-
Professional Education	77	79
Educational Profession	49	45
School Subjects (Elementary)	14	4
School Subjects (Secondary)	10	26
Graduation Thesis	4	4
Free Electives	22	20

Courses of Educational Profession

	Elementary	Lower-Secondary
Orientation for Teaching Profession	2	2
Foundation of Education	Total 8	Total 8
Rationale, Philosophy, History of Education	more than 2	more than 2
Children's Mental & Physical Development And Learning Process	more than 2	more than 2
Sociology, System and Management of Education	more than 2	more than 2
Curriculum & Instruction	28	24
Curriculum Development and Teaching Method of Special Activities	required 2	required 2
Methods and Skills of Education	required 4	required 2
Teaching Methods of Subjects (Elementary)	required 18	required 12
Teaching Methods of Special Subjects	required 2	required 6
Teaching Methods of Moral Education	required 2	required 2
Guidance and Counseling	4	4
Comprehensive Seminar	required 2	required 2
Student Teaching	5	5
Total	**49**	**45**

8. Career Promotion of Teachers

Table 3 indicates a typical career promotion of Japanese teachers. As is found, there are no administrative specific professionals in Japan, while teachers promote to such administrative positions as principal or vice principal. This means that older generation always occupies supervising or administrative positions in a certain school, thus, seniority, which is one of the traditional virtues, is never violated in the school. Since all the administrative people in schools are experienced teachers by themselves, they can readily share difficulty and problems to which younger teachers are sometimes facing and give appropriate advice to resolve such difficulty for them.

9. Demographic information on science teachers

Ogawa (2001) shows demographic state of Japanese science teachers as the ratio of science teachers per elementary school is about 1.17 with about 290 pupils per science teacher, that for lower-secondary school is about 3.19 with 152 students per science teacher, and that for upper-secondary school is about 6.55 with about 170 students per science teacher. Other precise data can be found in Ogawa (2001, Table 3).

10. Pre-Service Science Teacher Training Programs

Pre-service science teachers are trained in two types of institutions. The first one is in the majors of the professional teacher training institutions, that is, University of Education, and Faculty of Education in mainly national universities. In this type of institutions, the whole program is closely linked to the teacher certification system especially in elementary and lower secondary level, and most of the students cannot graduate without getting any teacher certificates, thus, most graduates of science majors have become science teachers mainly in elementary and lower secondary level. The second one is in the minor programs in the Faculties of Science, of Engineering, and of Agriculture in universities. Students are, in addition to their respective majors, required to enroll in a teacher education minor program, which consists of a set of courses on Foundations, Curriculum and Instruction, and Student Teaching, in order to obtain the science teacher certificate, mainly of upper secondary level. A significant number of graduates from such science related Faculties has been serving as science teacher at upper secondary schools (see Table 3 of Ogawa, 2001).

The major difference in the course requirement for pre-service science teachers between lower and upper secondary levels is in the academic (science related) contents. While pre-service lower secondary science teachers are asked to learn laboratory classes in every four realms of science (physics, chemistry, biology, and earth sciences), pre-service upper secondary teachers are required to learn at least one laboratory class in the four realms. Since the graduates of Faculties

Table 3. A typical career promotion of Japanese teachers

Age	Position and Job
18-23	Pre-service Training (at Faculty of Education)
22-28	Newly Adopted Teacher (Appointment Exams) (Sometimes Part-time Basis before Getting Permanent Positions)
32-35	Head Teachers of Subjects
38-45	Head Teacher of School Curriculum
42-50	Promotion Exams for Administrative Positions (Recommendation of Principal for Application) Supervisor of Prefectural Board of Education
45-55	Vice-Principal
48-57	Principal Senior Supervisor, Superintendent
60	Retirement

of Science, of Engineering, and of Agriculture are majoring mainly within one of the four realms of science, it is easy for them to get the upper secondary teacher certificate. This is the main reason why most of them are serving not as lower secondary, but as upper secondary science teachers.

11. In-Service Science Teacher Training Programs

In-service teacher training programs can be divided into two main categories. The first one is the programs in which all the teachers should enroll by the direction of the Board of Education. The second one is the programs in which teachers wanting to be involved can enroll. Among the first type, there are three major programs: Program for the first-year teachers, Program for the fifth-year teachers, and Program for tenth-year teachers. The program for the first-year teachers continues for one year. Each newly recruited teacher should be under the supervision of a veteran teacher in the same school, and he/she can get advice and information on his/her daily activities on teaching and management from his/her own supervisor usually two days a week. This is a kind of on-the-job-training.

In addition, all the new teachers visit one day a week (for about 30 weeks) at the Teacher Training Center of the Prefecture and have lectures and workshops on teaching and class management, or perform demonstrations in respective subject areas. In each of the 6 day in-service programs for the fifth-year and for the tenth-year teachers, which are held at the Teacher Training Center of the Prefecture, they have lectures and workshops, and give presentations on their own classes, demonstrations and experiments. Among the second type of the programs, the major one is the graduate program for practicing teachers at the University near by. In-Service

teacher training in the graduate programs at the University is a rather new scheme. Talented teachers selected through the screening by the Board of Education (mainly by the examination and interviews) have a chance to enroll in the graduate programs (Master of Education programs) at the University. They learn as the full-time students for the first year and as the part-time students for the second year. The Board of Education pays 100% salary for these two years. On graduation they get the M.Ed. degree. The number of such teachers is only about 15 each year in Ibaraki Prefecture.

There are also other programs for teachers with a rather short-term (3 or 6 months) stay in university under the supervision of university professors. In this case, teachers are selected by the Board of Education and sent to the university with 100% salary guaranteed, but they cannot obtain any credits or certificates of the university even enrolling certain formal classes, because they are in the status of 'visitors'. However, this scheme has a long history and more than 60 teachers can enroll in this scheme each year in Ibaraki Prefecture. Such teachers have been serving as leaders in each school district. Just is the case of science teachers. The Teacher Training Center of each Prefecture have been presenting various kinds of short programs for teachers who want to cultivate their own knowledge and teaching skills. Most of them are open in summer holiday season.