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A Joint Cross-National Questionnaire Survey on the Literacy in Science and Technology and Use of Radiation Among High-School Students in Seven FNCA Countries: 2002-2003

Issue July 2005

ABSTRACT

The present questionnaire survey was designed and carried out in a 2002-2003 time period by the Project on Public Information on Nuclear Energy under the auspices of the Forum for Nuclear Cooperation in Asia (FNCA).

Radiation and radioisotopes are widely used in various fields affecting people's life. This simple fact, however, is not always well recognized by the public, however. Hence, it was held appropriate to examine the general literacy in science and technology and use of radiation among high-school male and female students in FNCA member countries.

In 2002, FNCA's seven Public Information Project Leaders came to agree to launch a joint questionnaire survey in a 2002-2003 time period. The final output of the cross-national collaboration is this report. Part of the present report has been published by the Japan Atomic Industrial Forum, Inc. (JAIF), entitled "The Joint Survey on the Understanding of and the Interest in Radiation Among High-School Students in Seven FNCA Countries." Seven FNCA member countries which participated in this joint cross-national survey were China, Indonesia, Japan, Korea, the Philippines, Thailand, and Viet Nam. Australia which did not participate in the survey, nonetheless, contributed an evaluative comment on the findings of this survey. Major findings of the survey are described and discussed in this report, together with the evaluative comments submitted by the Project Leaders of the seven participating countries.

About This Survey

The present report presents the major findings of a Cross-national Joint Questionnaire Survey which was carried out in seven FNCA countries from the Fall of 2002 through end of 2003. These seven FNCA countries were China, Indonesia, Japan, Korea, the Philippines, Thailand and Viet Nam. Malaysia was also with the Project at the outset but dropped off at a later stage. The purpose of the survey was to investigate the "literacy" of 1,000 male and female high-school students in each country regarding science and technology, and use of radiation.

The present survey was the first joint collaborative effort made by FNCA countries in the Public Information area. It successfully examined the extent to which male and female high-school students in seven FNCA countries learn and think of science and technology and use of radiation and the way in which they use various communication sources in their learning. It was expected that the result obtained from this cross-national joint survey would not only serve to reveal the degree of the literacy in science and technology and use of radiation among high-school students, but also would prove useful to improve the method and quality of high-school education in science and technology, and use of radiation, in each country.

Method and Procedures of the Survey

The Questionnaire

Firstly, sample question items were constructed in Japanese by a small working group of survey specialists

in Japan. These sample questions were subsequently translated into English and were sent to Public Information Project Leaders of FNCA countries for review and comment. Project Leaders were also asked if possible addition of some indigenous question items should be desired as country-specific in his or her country. By this time, seven FNCA countries had expressed their willingness to participate in this joint endeavor.

Secondly, it was later found that the time available in classes at local high-schools for respondents' completing the questionnaire would be far more limited than had been initially expected – that is, in a range of only 15 to 30 minutes due to the tight teaching schedule in most high-schools. Consequently, the number of questions had to be cut short considerably.

Finally, a standard questionnaire was drafted in English by the Japanese Working Group. The draft questionnaire which consisted of a total of 20 question items, including 8 face-sheet question items, was sent to the Project Leader of each participating country for review and comments. With some modifications, this final English version was adopted and then translated into an indigenous language for use in high-school classes in each country.

The Respondents

Respondents in each country were 1000 male and female high-school students. Most high-schools were located in metropolitan areas. High-school students were chosen as appropriate respondents for two reasons. Firstly, they were considered as adequately representative of the next generation in every country, and secondly, they were considered as meeting the methodological requirement of obtaining 500 male and 500 female respondents in each country. The Project Leader of each country was held responsible for making appropriate arrangements with local high-schools.

The Procedures

In the Fall of 2002, the English version of the standard questionnaire text and figures (photographs) were sent to each Project Leader with a brochure containing a set of instructions (in English) for local high-school teachers who would administer the questionnaire in their classes. The English version of the brochure was translated into an indigenous language for use in classes. A standard "coding sheet" (a recording form) was also sent to each Project Leader for tabulating the obtained data from each respondent. Data were collected variably in seven countries from fall through winter of 2002 and the obtained data were sent to Japan for computer tabulation and analysis. All computer tabulation and analysis were done in Japan both by country and across countries. By the end of 2003, most computer analysis had been completed.

For the convenience of the reader of this report, the English version of "the Questionnaire Text and Figures", "the Instructions for Teachers", and "the Coding Sheet" will be attached to this Report as an Appendix.

Toward a very late stage of cross-national analysis, that is, toward end of 2003, it was discovered that Malaysia was not able to administer the survey for various reasons and dropped off, thereby reducing the number of the participating countries from eight to seven. Korea which made their own computer tabulation failed to turn in the original data. Without the original data, tabulation by question item across nations was not possible for Korea. Consequently, although Korea is shown in each case of cross-national comparisons, it should be treated as an independent entity. Furthermore, one of the face-sheet questions (F3) in the Japanese questionnaire provided, by an error, a somewhat different set of alternative answers than the rest of the countries, to make the Japanese data incomparable to the other.

ATTRIBUTES OF HIGH-SCHOOL STUDENTS: WHO WERE OUR RESPONDENTS?

In general terms, it may be safe to say with caution that the results obtained in the present survey is by no means "generalizable", because selection of respondents was dictated by practical consideration like availability, not so much by consideration of sampling theory. Table F1 shows how the conditions of respondents varied from country to country. And yet, as it will be seen later, most findings are interesting, some are provocative, and others are intriguing. Now, before getting to the major findings, let us first see who our respondents were and how our data were collected in each country.

(1) Percentage of Male and Female High-School Students (F1)

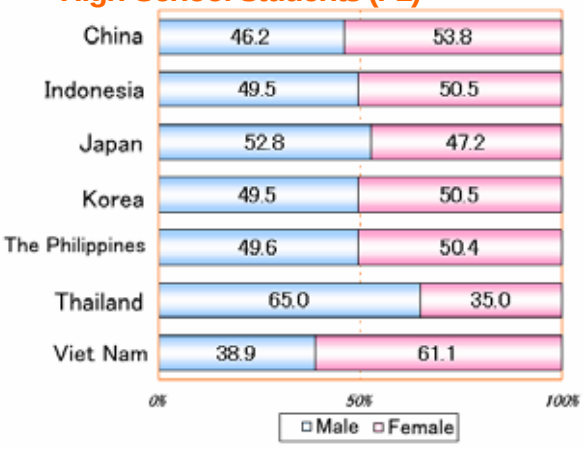


Figure F1 Percentage of Male and Female High-School Students, by Country

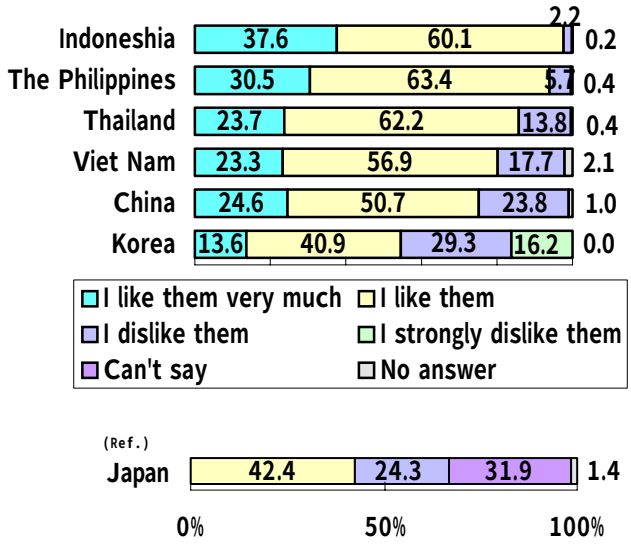
It had been previously agreed upon by the Project Leaders that respondents should be 500 male and 500 female high-school students, totaling 1000, in each country. Figure F1 shows that the expected 50:50 male - vs. - female ratio was reasonably attained everywhere. Table F1 below displays: (1) Countries; and (2) the Numbers of Male and Female Students.

Table F1 Conditions of Data Collection, by Country

Country	No. of Students		
	Male	Female	Subtotal
China	485 (46.2%)	565 (53.8%)	1050 *1
Indonesia	551 (49.5%)	562 (50.5%)	1113 *2
Japan	610 (52.8%)	546 (47.2%)	1156 *3
Korea	495 (49.5%)	505 (50.5%)	1000
The Philippines	564 (49.6%)	574 (50.4%)	1138 *4
Thailand	911 (65.0%)	491 (35.0%)	1402 *5
Viet Nam	351 (38.9%)	552 (61.1%)	903 *6
Total	3967 (51.1%)	3795 (48.9%)	7762
	7762 (excl. 75 not identifiable in sex)		

(2) Like or Dislike of Science Courses (F3)

Figure F3 Like or Dislike of Science Courses

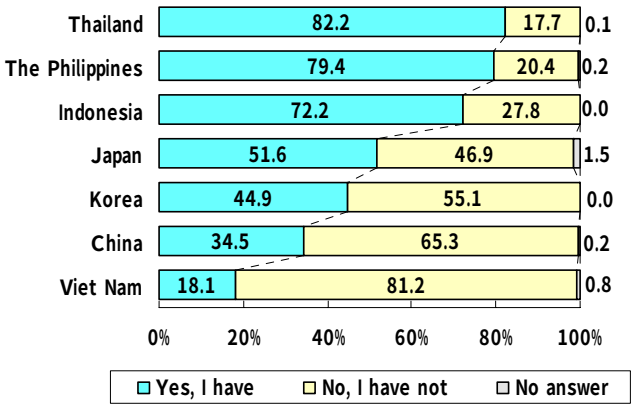


Next, in order to examine whether respondents may like or dislike science courses given at school, they were requested to rate the science courses given at school on a "like-or- dislike" scale. However, there was some inconsistency in the question. A five-point scale ("I like them very much"; "I like them"; "I dislike them"; "I dislike them very much"; and "I cannot say") was used in six countries - China, Indonesia, Korea, the Philippines, Thailand and Viet Nam. In Japan, on the other hand, a three-point scale ("I like them"; "I dislike them"; and "I cannot say") was used. Because of this inconsistency, Japanese data was not comparable with the rest and treated separately, as is shown in Figure F3.

It is seen in Figure F3 that a very large number of male and female high-school students answered either "I like them very much" or "I like them" in Indonesia (97.7%), the Philippines (93.9%), Thailand (85.9%) and Viet Nam (80.2%). In Korea, however, only one out of two students answered either "I like them very much" or "I like them". Although no direct comparison is possible because a different scale was used, only 40% of Japanese students positively answered, "I like them". This may be taken as an indication of psychological detachment of many Japanese students from the science courses given at school.

(3) Teaching of "Radiation" and/or "Radioactivity" in Classes (F4)

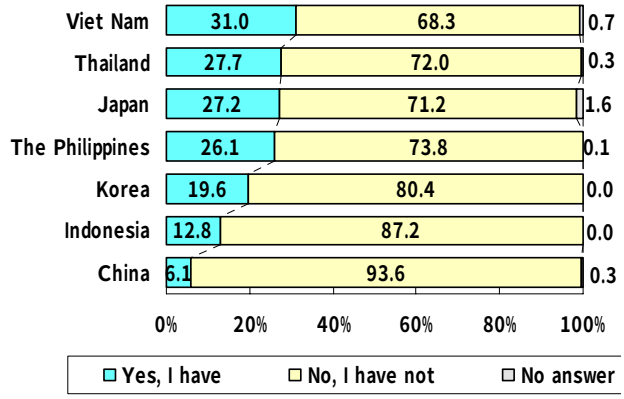
Figure F4 Teaching of "Radiation" and / or "Radioactivity" in Classes



To the question "Have you ever been taught about "radiation" or "radioactivity" at school?", more than 70% of students answered "Yes" in Thailand, the Philippines and Indonesia. The percentage that answered "Yes" was found the lowest (18%) in Viet Nam. Surprisingly, only 52% of the Japanese students said "Yes", despite the fact that Japan is the largest nuclear-energy- producing country in Asia.

(4) Visit to Radiation-related Facilities and Exhibitions (F5)

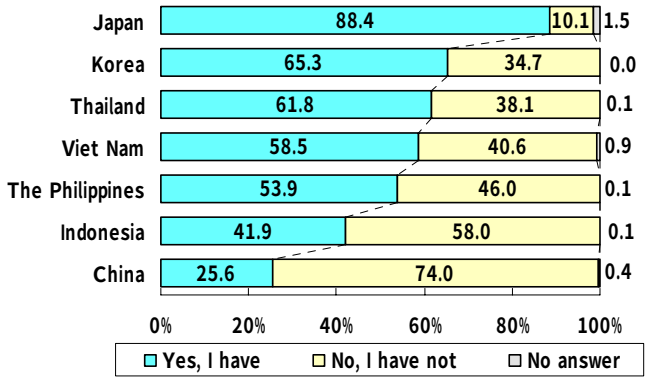
Figure F5 Visit to Radiation-related Facilities and Exhibitions



To the question "Have you ever visited a university, a research institute, or science and technology exhibition to learn about 'radiation'?", more than 60% of students in every country answered "No". The percentage was found the highest in Viet Nam (31%), and the lowest in China (6%).

(5) Past X-ray Examinations (F6)

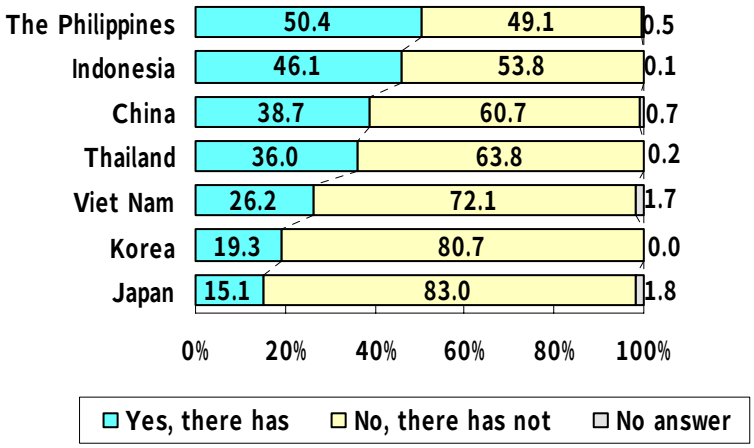
Figure F6 Past X-ray Examinations



To this question, "Have you ever had an X-ray picture taken?", more than 50% of students in most countries except Indonesia and China answered "Yes". The percentage was found the highest in Japan (88%) and the lowest in China (26%).

(6) Radiation Therapy of Family Members or Acquaintances (F7)

Figure F7 Radiation Therapy of Family Members or Acquaintances



To the question "Has anyone in your family, or have any of your acquaintances, ever received medical care involving radiation?", more than 50% students in six countries except the Philippines answered "No".

Several reasons can be speculated. First, radiation therapy in fact is not very familiar. Second, students had only insufficient knowledge of radiation therapy.

Third, students had only insufficient knowledge as to whether their family members or acquaintances had radiation therapy.

Public Information (PI)

Outline of the FNCA Project on Public Information

In order to develop the applications of nuclear science and technology for the sustainable societal and economic growth, public information (PI) activities regarding nuclear science and technology are considered indispensable to enhance the public understanding. FNCA nuclear public information activities used to be carried out mainly with emphasis on information exchange among the FNCA countries for about ten years since 1991.

(7) Visit to Museum, Public Library, Scientific Institution, Power-Generation Plant and Other Public Facilities (F8)

Table F8 Visit to Museum, Public Library, Scientific Institution, Power-Generation Plant and Other Public Facilities

	Category	China		Indonesia		Japan	
		n	%	n	%	n	%
1	Museum	698	66.5	1017	91.4	1018	88.1
2	Zoo, Botanical Garden, or Aquarium	796	75.8	1057	95.0	1062	91.9
3	Power Generation Plant	942	89.7	246	22.1	393	34.0
4	Art Museum	508	48.4	553	49.7	919	79.5
5	Public Library	251	23.9	571	51.3	1061	91.8
6	Scientific Institution	507	48.3	276	24.8	522	45.2

	Category	Philippines		Thailand		Viet Nam	
		n	%	n	%	n	%
1	Museum	1005	88.3	956	68.2	782	86.6
2	Zoo, Botanical Garden, or Aquarium	933	82.0	841	60.0	778	86.2
3	Power Generation Plant	311	27.3	316	22.5	57	6.3
4	Art Museum	714	62.7	436	31.1	517	57.3
5	Public Library	721	63.4	736	52.5	653	72.3
6	Scientific Institution	644	56.6	434	31.0	140	15.5

	Category	Korea	
		n	%
1	Natural Museum	-	49.4
2	Zoo or Botanical Plant	-	86.5
3	Power Generation Plant	-	66.8
4	Art Museum	-	37.3
5	Public Library	-	75.1
6	Museum That Has Exhibits of Science and Technology	-	97.0
7	Aquarium	-	46.1
8	Fair That Has Displays in Relation to Science and Technology	-	48.5

Korea was not included in this cross-tabulation comparison because of lack of the original data and a somewhat different set of alternative category items used exclusively in Korea. Only percentages are shown for Korean data as a separate entity.

It will be seen in Table F8 that both “Museum” and “Zoo or Botanical Garden” appear the most popular public facilities to be visited almost all countries. “Art Museum” also appears popular. In China, considerably fewer high-school respondents (23.9%) mentioned “Public Library” than other countries, probably because of lack or scarcity of “Public Library” in the neighborhood. Conversely, nine out of ten Japanese high-school students (91.8%) answered that they had visited “Public Library”. This may be taken as an indication of easy access to local “Public Library” and a real need for high-school students to use “Public Library” for winning a severe competition for the entrance examination to college and university.

On the other hand, a surprisingly large number of Chinese high-school students (89.7%) said that they had visited “Power-Generation Plant”. According to a Chinese informant, it is said that, in China, high-school students are encouraged to visit “Power-Generation Plant”. As for “Scientific Institution”, on the average, only one out of two high-school students said that they had visited “Scientific Institution”. Some “open-door” policy may be necessary on the part of “Scientific Institution” to attract and stimulate the interest and curiosity of the youth in science.

RESPONSES OBTAINED FROM HIGH-SCHOOL STUDENTS REGARDING SCIENCE, TECHNOLOGY, AND USE OF RADIATION

(1) Issues and Events High-School Students Are Most Interested In (Q1)

Table Q1 Issues and Events High-School Students Are Most Interested In.

RANKING \ COUNTRY	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Korea
1	School Life and Friends	Science and Technology	My Own Future	Science and Technology	My Own Future	My Own Future	Science and Technology *1
	41.8	77.4	50.3	45.5	61.2	67.9	79.6
2	Family Life	Culture and Sports	Culture and Sports	My Own Future	Science and Technology	Politics and Economics	School Life and Friends
	41.4	44.9	47.6	44.6	47.0	48.3	56.8
3	My Own Future	Medical Care and Health	School Life and Friends	School Life and Friends	Energy and Environment	Science and Technology	Culture and Sports
	36.0	42.2	46.5	42.9	31.8	38.9	49.3
4	Culture and Sports	School Life and Friends	Medical Care and Health	Medical Care and Health	Medical Care and Health	Medical Care and Health	Politics and Economics *2
	34.7	32.0	25.3	36.3	30.0	34.3	40.1
5	Regional Dispute and Diplomatic Issues	My Own Future	Science and Technology	Culture and Sports	Family Life	Culture and Sports	My Own Future
	27.7	31.6	21.9	32.0	29.4	33.7	38.5
6	Medical Care and Health	Energy and Environment	Politics and Economics	Family Life	School Life and Friends	Energy and Environment	Regional Dispute and Diplomatic Issues
	24.5	29.6	20.7	24.1	29.2	24.0	32.8
7	Population and Food	Family Life	Energy and Environment	Politics and Economics	Culture and Sports	School Life and Friends	Medical Care and Health
	21.2	15.0	18.4	23.6	27.7	17.3	31.7
8	Politics and Economics	Politics and Economics	Regional Dispute and Diplomatic Issues	Energy and Environment	Politics and Economics	Family Life	Energy and Environment
	20.7	14.6	17.5	22.8	20.3	13.3	23.9
9	Science and Technology	Population and Food	Family Life	Population and Food	Population and Food	Regional Dispute and Diplomatic Issues	Population and Food
	17.0	6.4	14.7	16.6	9.7	9.7	15.7
10	Energy and Environment	Regional Dispute and Diplomatic Issues	Population and Food	Regional Dispute and Diplomatic Issues	Regional Dispute and Diplomatic Issues	Population and Food	-
	12.2	4.9	10.8	6.7	8.6	9.6	-

*1) In Korea, a phrase "the Newest Technologies and Scientific Discoveries" were used instead of "Science and Technology."
*2) In Korea, a phrase"Political Issues and Economic Issues" was used instead of "Politics and Economics."

Q1 was a multiple choice question. Students were asked to choose three issues or events that they are most interested in out of ten alternatives. In this cross-tabulation across countries which is shown in Table Q1, Korea was not included because of lack of original data and use of different alternatives. Korean data shown in the table is incomparable with those of other countries.

Firstly, it is clearly shown in Table Q1 that high-school students are most interested both in some close and familiar things and events, such as “My Own Future” (colored in light blue) and in some remote and abstract things and events, such as “Science and Technology” (colored in yellow). “My Own Future”, for example, is ranked very high and is among the top five in every country. Similarly, “Science and Technology” is ranked very high, also among the top five in every country except China. Secondly, Interest in “Energy and Environment” is relatively high in Thailand (31.8%) and Indonesia (29.6%) but very low in China (12.2%), Japan (18.4%), the Philippines (22.8%), Korea (23.9) and Viet Nam (24.0%). Despite the anticipated critical shortage of energy accruing from rapid industrialization and the rapidly increasing green-house gas effect in the Asia-Pacific region, the foregoing findings seem to suggest a clear lack of interest in “Energy and Environment” issues among the high-school students in FNCA countries generally.

One might have an impression that high-school students should be made more aware of the contemporary crisis which all the people in the 21st -century is being confronted with --- the “Trilemma” which refers to the serious contradiction among “Economic Growth”, “Energy Consumption” and “Green house Gas”. Thirdly, Chinese students seem to show a unique cultural tendency in that they are more interested in close and familiar “human” events, such as “School Life and Friends” (41.8%), “Family Life” (41.4%) and “My Own Future” (36.0%) than in remote and abstract “material” events, such as “Energy and Environment” (12.2%), “Science and Technology” (17.0) and “Politics and Economics” (20.7%).

(2) Sources of Information regarding Science and Technology (Q2)

Table Q2 Sources of Information regarding Science and Technology

RANKING \ COUNTRY	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Korea
1	TV&Radio	TV&Radio	TV&Radio	TV&Radio	TV&Radio	TV&Radio	TV&Radio
	82.3	92.3	84.7	87.8	86.2	95.1	74.8
2	Scientific Magazines and Books	Newspapers	Newspapers	Internet	Newspapers	Newspapers	Internet
	60.8	65.4	52.3	77.7	62.5	83.8	71.7
3	Internet	School Teacher(s)	School Textbooks	School Teacher(s)	Internet	Scientific Magazines and Books	Friends
	58.8	65.3	41.2	67.1	50.0	55.9	48.4
4	Newspapers	School Textbooks	Internet	Newspapers	School Teacher(s)	Internet	Newspapers
	58.2	59.5	40.1	61.0	39.7	50.6	32.5
5	Friends	Friends	School Teacher(s)	Scientific Magazines and Books	School Textbooks	School Teacher(s)	School Textbooks
	38.1	57.0	35.8	57.4	36.9	39.1	31.3
6	School Textbooks	Scientific Magazines and Books	Family Members (Parents and Brother/Sister)	School Textbooks	Friends	Friends	Scientific Magazines and Books
	35.4	52.4	26.2	55.4	35.3	34.9	27.2
7	Family Members (Parents and Brother/Sister)	Internet	Cartoons and Comic Books	Exhibits, Fairs, or Seminars	Scientific Magazines and Books	School Textbooks	Cartoons and Comic Books
	32.2	50.7	24.3	54.7	30.0	32.7	27.1
8	School Teacher(s)	Family Members (Parents and Brother/Sister)	Scientific Magazines and Books	Friends	Exhibits, Fairs, or Seminars	Family Members (Parents and Brother/Sister)	Family Members (Parents and Brother/Sister)
	30.6	44.9	18.3	47.3	28.8	32.7	14.4
9	Cartoons and Comic Books	Exhibits, Fairs, or Seminars	Friends	Family Members (Parents and Brother/Sister)	Family Members (Parents and Brother/Sister)	Exhibits, Fairs, or Seminars	School Teacher(s)
	18.3	39.1	15.3	45.3	27.2	29.7	11.9
10	Church, Mosque, or Temple	Church, Mosque, or Temple	Exhibits, Fairs, or Seminars	Cartoons and Comic Books	Cartoons and Comic Books	Cartoons and Comic Books	Church, Mosque, or Temple
	5.7	20.5	8.5	19.9	10.9	15.6	0.93
11	Exhibits, Fairs, or Seminars	Cartoons and Comic Books	Church, Mosque, or Temple	Church, Mosque, or Temple	Church, Mosque, or Temple	Church, Mosque, or Temple	- ※1
	2.7	18.4	1.4	14.0	1.7	3.2	-

Korea was excluded from this cross-tabulation across countries because of lack of original data and a different set of alternative category items used. As shown in Table 3-2-1, the category item “Exhibits, Fairs or Seminars” (*1) is not included in Korea.

Firstly, it is clearly seen in Table Q2 that the three most frequently referred-to sources of information regarding science and technology are mass media like “TV & Radio” (colored in orange), “Newspapers” (also colored in orange) and new electronic media like “Internet” (colored in yellow) in almost every country. “TV and Radio” proved the most dominant source of information regarding science and technology with more than 75% of high-school students mentioning it in each country. More than 50% of high-school students are found to use “Internet” in the Philippines (77.7%), Korea (71.7%), China (50.7%), Indonesia (50.7%) and Viet Nam (50.6%) except Japan (40.1%). Surprisingly, the percentage of the Japanese who mention “Internet” is the lowest (40.1%) among the seven FNCA countries. There may be some peculiar limitation for Japanese high-school students to use “Internet”, whether it may be an information infrastructure, a high cost, a school system, a family situation, a lifestyle, a personal preference, or a combination of these. Secondly, school provides important sources of information regarding science and technology as might be expected. “School teachers” (colored in pink) is ranked high in Indonesia (65.3%) and the Philippines (67.1%). “School Textbooks” (colored in light green) is rated high in Indonesia (59.5%) and Japan (41.2%). “Friend” (colored in white) is also mentioned frequently in Indonesia (57.0%). “Scientific Magazines and Books” (colored in light blue) is frequently referred to in China (60.8%), the Philippines (57.4%), Viet Nam (55.9%) and Indonesia (52.4%). Conversely, only very few mentioned “Scientific Magazines and Books” in Japan (18.3%). “Cartoons and Comic Books” (colored in white) also seems to provide a good source of information regarding science and technology for one out of four high-school students in Korea (27.1%) and Japan (24.3%).

(3) General Knowledge regarding Science and Technology (Q3)

Table Q3 "Following are statements about science and technology. Do you think the following information about science and technology is right or wrong? Please select one item among the three choices." (Q3)

(Figures are the percentage of correct answers)

Question \ COUNTRY	China	Indonesia	Japan	Korea	The Philippines	Thailand	Vietnam	Ave.
Q3-1.The temperature at the center of the Earth is very hot (right)	81.8	89.7	88.7	77.0	82.9	79.2	86.3	83.7
Q3-2.Materials that emit radiation are all artificially made (wrong)	82.2	79.8	74.2	53.0	70.7	75.0	75.5	72.9
Q3-3.Oxygen in the air is mainly produced by photosynthesis in green plants (right)	74.6	85.4	76.9	74.0	77.7	68.3	76.9	76.3
Q3-4.A laser concentrates acoustic waves (wrong)	45.6	9.2	31.5	30.0	28.8	49.0	34.1	32.6
Q3-5.An electron is smaller than an atom (right)	58.5	59.6	71.3	34.0	68.7	73.0	63.9	61.3
Q3-6.The factor that determines the sex of a child is genes of a father (right)	54.6	34.1	31.9	47.0	26.7	50.6	65.5	44.3
Q3-7.The major reason for global warming is the release of chlorofluorocarbon gases (wrong)	59.6	34.1	43.4	29.0	34.2	19.4	47.7	38.2

(NOTE) 1) Figures in the table means ratio of right answer (%).
2) : More than 70% right answers
3) : Less than 30% right answers
4) : Highest percentage of right answers among the seven countries
5) Ave. : Mean value of the seven countries

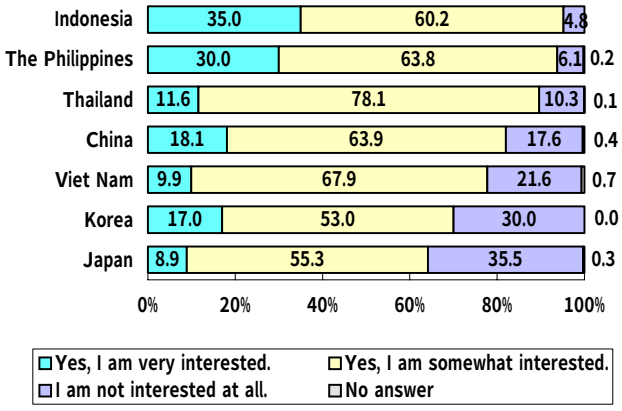
In order to examine the degree of the general science literacy, seven questions were given to the students. They were asked to answer each question by choosing either "True" or "False". Table Q3 shows the percentage of those who gave the correct answers and the average percentage for each question.

In every country, the respondents displayed their sufficient past learning about "The temperature at the center of the earth", (Q3-1), ""Oxygen in the air is mainly produced by photosynthesis" (Q3-3) and "Materials that emit radiation" (Q3-2), with the average percentage above 70%.

This is an indication that the students must have learned about these topics at school very well. In contrast, however, they showed their lack of their past learning about "The factor that determines the sex of a child" (Q3-6), "The major reason for global warming" (Q3-7) and "A laser concentrates acoustic waves" (Q3-4), probably because they might not have learned about them at school due to the absence of these topics in the high-schools curriculum. "Sex and the genetics" may be a sensitive topic in some countries to be taught in classes. Both "global warming" and "a laser" may be too novel topics to teach at school. Nonetheless, in view of the real and pressing importance in the contemporary world, more information should be given to the students in school classes regarding these topics.

(4) Interest in Topics Involving Radiation (Q4)

Table Q4 "Are you interested in topics involving radiation? Please select one among the three choices."(Q4)

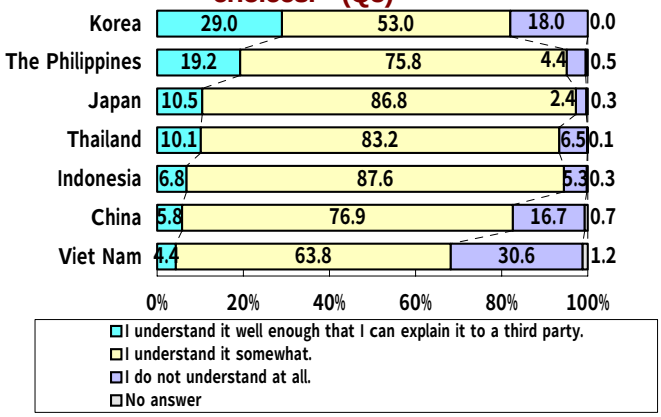


nd in knowing how much high-school students are interested in a highly sophisticated topic like "radiation". It is intriguing to find that a large number (more than 80%) of students in non-nuclear countries are interested in topics related to radiation. In contrast, however, advanced nuclear power producing - countries, such as Japan and Korea, much fewer students (less than 70%) are interested in radiation-related topics. Several reasons may be

considered. Firstly, it seems clear that Japanese and Korean students are already so much accustomed to the topics related to nuclear energy, radiation, and radioactive waste, etc., such that topics related to radiation no longer evoke any specific interest to them. Secondly, Japanese and Korean students may have come across a number of anti-nuclear demonstrations by citizens groups, labor unions, and political parties. Often, radiation and radiation-related objects are loaded with negative values. Few people would be interested in knowing more about something having negative values. Thirdly, Japan and Korea may have reached a stage of "affluent society". In an affluent society, it is said, interest of the youth may generally lie in getting more immediate "material" reward, such as "getting rich", "success in the entrance examination to university", "contesting a complex computer game with someone" or "a virtual identification with heroes and heroines in their own popular art and culture." Radiation, then, may be too distant from their ordinary sphere of interest.

(5) Self-rated Understanding of Radiation (Q5)

Table Q5 "To what extent do you understand the word 'radiation'? Please select one among the three choices." (Q5)



"Having an ability to teach" is different from "knowing something" because the former requires much more learning and more confidence in what one has learned.

In the preceding Q4, there are remarkably fewer Korean and Japanese respondents who said "I am interested in radiation-related topic", while there are remarkably more Koreans and Japanese who answered "I am not interested". For Q5, however, the percentage of those who answered "I understand it (radiation) well enough that I can explain it to a third party" is greater in the Koreans (29.0%) and the Japanese (10.5%) along with the Filipinos (19.2%). As exemplified by these cases, interest and understanding may be of different psychological qualities. Consequently, it may be necessary for teachers in Korea and Japan to make the radiation-related topics more "interesting" to their students so that they may voluntarily try to know more about radiation and related topics. As a whole, the obtained result is quite encouraging because more than 80% of the respondents of the six countries, except the Vietnamese (68.2%), said that they variably "understand radiation". This is a good sign for respondents to speak out their learning motivation and confidence in understanding radiation, clearly.

(6) Affective Images of Radiation (Q6)

It looks clear in Table Q6 that the most dominant affective images of radiation are "Dangerous" (light blue) and yet "Useful" (yellow) and "Promising" (dark blue) in most countries. These inconsistent (both good and bad) affective images indicate a salient psychological ambivalence which most respondents might have toward Radiation. In addition, "Controllable" is also taken as an important affective image of Radiation by a majority of respondents in Viet Nam (75%), Korea (65%), Thailand (58%), China (54.5%) and Indonesia (51.8%). On the other hand, the Japanese appear most skeptical of "Controllable" radiation, because only 21.7% of respondents accept that image. It is posited in the behavioral science that the affective images are quite influential to the directions of preferential behavior and decision-making. If this hypothesis is acceptable, the salient ambivalence toward radiation would make the decisions fluctuate between acceptance and rejection from time to time in accordance with the occurrence of external events, such as an occurrence of radiation accident.

Table Q6 "Following are statements about "radiation." Please select one answer among the five choices that best describes your opinion."(Q6)

COUNTRY RANKING	China	Indonesia	Japan	Korea	The Philippines	Thailand	Viet Nam
1	Dangerous	Dangerous	Dangerous	Promising	Familiar	Promising	Dangerous
	81.6 (58.7)	84.7 (62.7)	87.2 (65.1)	72.0 (12.0)	84.6 (48.1)	88.6 (68.6)	93.8 (61.5)
2	Promising	Useful	Useful	Dangerous	Dangerous	Dangerous	Useful
	72.9 (52.2)	81.7 (63.8)	57.6 (27.0)	71.0 (28.0)	83.7 (55.6)	86.1 (65.1)	87.7 (9.6)
3	Useful	Familiar	Promising	Useful	Useful	Useful	Promising
	70.4 (50.2)	70.1 (48.3)	48.0 (23.8)	68.0 (23.0)	78.8 (34.6)	85.2 (53.9)	76.1 (52.3)
4	Controllable	Controllable	Mysterious	Mysterious	Promising	Controllable	Controllable
	54.5 (27.8)	51.8 (28.8)	43.6 (19.7)	67.0 (20.0)	54.3 (16.3)	58.6 (25.9)	75.0 (34.4)
5	Familiar	Mysterious	Weird	Controllable	Mysterious	Familiar	Weird
	43.5 (15.6)	47.2 (29.4)	41.5 (18.4)	65.0 (11.0)	52.6 (26.4)	44.7 (9.8)	64.9 (41.0)
6	Mysterious	Promising	Familiar	Familiar	Controllable	Mysterious	Familiar
	39.8 (15.1)	38.8 (16.0)	26.4 (9.9)	60.0 (28.0)	49.6 (19.5)	41.4 (15.5)	52.4 (22.9)
7	Weird	Weird	Controllable	Weird	Weird	Weird	Mysterious
	29.7 (12.5)	34.8 (16.3)	21.7 (7.5)	50.0 (8.0)	29.5 (10.8)	39.4 (19.0)	36.0 (17.8)

(NOTES) 1) In each cell, an "affective image" is represented by a word, such as "Dangerous". For each "affective image", respondents are asked to rate each "affective image" on a nominal scale consisting of five categories: "I agree"; "I agree slightly"; "I am not sure"; "I doubt it"; and "I do not think so". A figure in each cell is a combined percentage of "I agree" and "I agree slightly." A figure in parenthesis is a percentage of "I agree" alone.

(7) Cognitive Images of Radiation (Q7)

Table Q7 "What do you imagine when you hear the word "radiation"? Please select as many as you like." (Q7)

COUNTRY RANKING	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Korea
1	Mr. and Mrs. Curie	An X-ray Picture	Nuclear Power Generation	Nuclear Power Generation	An X-ray Picture	Cancer Therapy	Hiroshima, Nagasaki or Nuclear Weapons
	81.4	81.6	77.8	82.4	87.3	81.6	80.0
2	An X-ray Picture	Nuclear Power Generation	An X-ray Picture	An X-ray Picture	Cancer Therapy	Hiroshima, Nagasaki or Nuclear Weapons	Cancer Therapy
	69.0	75.7	75.6	76.1	66.4	80.6	57.0
3	Mutation Breeding of Crops	Hiroshima, Nagasaki or Nuclear Weapons	Hiroshima, Nagasaki or Nuclear Weapons	Hiroshima, Nagasaki or Nuclear Weapons	Nuclear Power Generation	Exposure	An X-ray Picture
	53.4	74.8	74.8	69.9	65.3	79.5	50.0
4	Hiroshima, Nagasaki or Nuclear Weapons	Cancer Therapy	Exposure	Cancer Therapy	Hiroshima, Nagasaki or Nuclear Weapons	An X-ray Picture	Food Irradiation
	52.1	60.6	71.0	66.0	57.6	78.2	40.8
5	Chernobyl	Mr. and Mrs. Curie	Chernobyl	Exposure	Waste	Nuclear Power Generation	Waste
	50.3	38.8	58.0	60.8	54.7	74.0	35.2
6	Leukemia	Mutation Breeding of Crops	Cancer Therapy	Mutation Breeding of Crops	Food Irradiation	Mutation Breeding of Crops	Chernobyl
	41.0	33.8	42.2	33.7	51.8	71.1	34.2
7	Nuclear Power Generation	Waste	Waste	Waste	Exposure	Mr. and Mrs. Curie	Mutation Breeding of Crops
	31.1	31.0	31.4	31.3	50.2	66.9	32.8
8	Waste	Food Irradiation	Leukemia	Leukemia	Mr. and Mrs. Curie	Food Irradiation	Mr. and Mrs. Curie
	23.4	24.7	26.8	26.6	34.9	52.4	32.5
9	Exposure	Leukemia	Mr. and Mrs. Curie	Mr. and Mrs. Curie	Mutation Breeding of Crops	Chernobyl	Nuclear Power Generation
	19.6	18.1	21.6	25.0	23.7	49.3	28.0
10	Cancer Therapy	Chernobyl	Mutation Breeding of Crops	Food Irradiation	Leukemia	Leukemia	Leukemia
	14.7	14.1	8.5	24.1	20.8	34.8	12.3
11	Food Irradiation	Exposure	Food Irradiation	Chernobyl	Chernobyl	Waste	Exposure
	7.4	3.1	8.0	23.2	17.4	26.4	4.3

In order to investigate the cumulative effect of past learning, a method of empirical analysis was developed by psychologists. The method is generally known as the Association Test. The present question (Q7) is constructed on the basis of this Association Test method. Given a set of 11 concepts, such as "Mr. and Mrs. Curie" or "Nuclear Power Generation", respondents are asked to choose as many among these "concepts" as possible which they feel are relevant to the stimulus term "Radiation". The concepts thus chosen constitute the cognitive images of

Radiation. These images in turn reflect the respondents' past cognitive experience with Radiation. Let us now turn to Table Q7. In the table, Korea was excluded from direct comparisons because no cross-national tabulation was possible due to lack of original data from Korea and because they used a somewhat different set of associates.

In Table Q7, both national uniqueness and across-national similarity can be observed. Let us first compare three nuclear power-producing countries, China, Korea and Japan. For the Chinese, five dominant (over 50%) cognitive images of Radiation are "Mr. and Mrs. Curie" (81.4%), "An X-ray Picture" (69.0%), "Mutation Breeding of Crops" (53.4%), "Hiroshima and Nagasaki" (52.1%) and Chernobyl" (50.3%). For the Koreans, they are "Hiroshima and Nagasaki" (80.0%), "Cancer Therapy" (57.0%) and "An X-ray Picture" (50.0%). For the Japanese, they are "Nuclear Power Generation" (77.8%), "An X-ray Picture" (75.6%), "Hiroshima and Nagasaki" (74.8%), "Exposure" (71.0%) and "Chernobyl" (58.0). It looks clear that the cognitive experience with "Hiroshima and Nagasaki" was no longer exclusive to the Japanese but shared by a majority of respondents in every country. Similarly, "Chernobyl" seems to have left a strong aftereffect in many respondents in most countries. On the other hand, "An X-ray Picture" is one of the most dominant (over 75%) cognitive images of Radiation in Indonesia (81.6%), Japan (75.6%), the Philippines (76.1%), Thailand (87.3%), and Viet Nam (78.2%). "Cancer Therapy" is another dominant (over 50%) image of Radiation in Indonesia (60.6%), the Philippines (66.0%), Thailand (66.4%) and Viet Nam (81.6%). "Food Irradiation" and "Mutation Breeding of Crops" tend to be associated with Radiation in countries where the primary industry is the leading industry. Only less than 10% of the urban Japanese associated them with Radiation, indicating a total lack of cognitive experience with use of radiation in agriculture and for agricultural products.

(8) Scientific Knowledge regarding Radiation (Q8)

Table Q8 The following are some statements about "radiation." Please select one that best meets your own idea." (Q8)

Percentage of Right Answers (%)

COUNTRY / ITEMS	China	Indonesia	Japan	Korea	The Philippines	Thailand	Viet Nam	Ave.
Q8-1.Materials that emit radiation have existed in nature since the creation of the Earth (right)	68.2	80.8	62.7	35.0	60.7	53.9	74.4	62.2
Q8-2.Intensity of emitted radiation will not change as time passes (wrong)	60.2	46.1	64.2	49.0	68.3	62.0	51.9	57.4
Q8-3.Radiation is also emitted from ordinary food even it is extremely low level (right)	31.1	28.9	49.0	36.0	50.4	39.7	19.9	36.4
Q8-4.Direction of radiation beams can be changed by strong winds (wrong)	34.9	34.7	50.3	49.0	56.7	54.9	54.3	47.8
Q8-5.Characteristics of natural radiation and artificial radiation are different (wrong)	19.7	8.4	19.3	49.0	19.8	22.0	23.4	23.1
Q8-6.The human body always emits radiation, but the radiation emitted is extremely low level only (right)	52.4	53.8	41.9	11.0	56.1	52.3	51.5	45.6

(NOTES) 1) Figures in the chart show the percentage of right answers (%).
2) ▭ : More than 70% right answers
3) ▭ : Less than 30% right answers.
4) ⬭ : Highest percentage of right answers among the seven countries.
5) Ave. : Mean value of the seven countries.

To discover whether they have accurate knowledge of Radiation, the respondents were asked to judge each of the six statements either as being "right" or as being "wrong". Figures in

cells in Table Q8 show the percentages of correct answers. For Questions 8-1 and 8-2, a reasonably large number (an average of over 50%) of the respondents gave correct answers. For Q8-5, however, respondents seem to have had difficulties in judging whether natural radiation and artificial radiation are the same or different. An average of only 23.1% answered correctly for this question. In retrospect, these questions were indeed difficult. Only specialists in radiation could answer these questions with ease.

(9) Self-rated Knowledge regarding Applications of Radiation (Q9)

Table Q9 "Radiation is used for various applications worldwide. Please let us know your knowledge about the following applications of radiation by selecting one among the four choices." (Q9)

ITEM \ COUNTRY	China	Indonesia	Japan	Korea	The Philippines	Thailand	Viet Nam
Q9-1.Mutation breeding of rice, wheat, soybean, flower, etc.	34.2	25.9	21.3	73.0	48.8	46.7	50.8
Q9-2.Examination of health conditions and function of organs of human beings	63.8	66.8	72.0	79.0	83.3	76.5	72.0
Q9-3.Decomposition and removal of air pollutants from exhaust gases of industrial plants	36.7	14.1	18.2	47.0	49.4	26.0	33.0
Q9-4.Retardation (Delay) of sprouting of potatoes, onions, and garlic	18.7	35.1	20.7	24.0	40.4	36.9	39.1
Q9-5.Cancer therapy	52.6	54.1	68.2	66.0	72.8	74.7	75.6
Q9-6.Sterilization of medical supplies like syringes	44.7	31.3	23.4	55.0	47.6	46.9	39.2
Q9-7.Baggage inspection at airports	55.0	34.9	57.0	56.0	74.6	68.7	55.5
Q9-8.Prevention of damage to crops and domestic animals by sterilizing harmful insects	25.9	32.2	14.1	46.0	45.7	35.0	27.2
Q9-9.Measurement of thickness of iron plates in iron factories	16.6	18.5	11.7	48.0	30.3	35.7	21.7
Q9-10.Nondestructive examination of statues and paintings of cultural value	23.2	18.9	33.8	44.0	34.8	40.5	39.6
Q9-11.Microanalysis of harmful pollutants in the air	24.7	14.9	23.5	44.0	45.0	25.7	28.6
Q9-12.Production of heat-resistant insulation for electric wires	16.7	15.7	10.2	55.0	46.8	24.3	21.7

(NOTE) 1) Figures in the chart show the sum of "I know well" and "I know t
2) : Exceeds 70%
3) : Less than 30%.
4) : Highest among the countries.

Q9 is a multiple-choice question. A total of 12 applications of radiation (3 in agriculture, 3 in medicine, and 6 in industry) were shown to the students. Students were asked to rate their knowledge of each application. Table Q9 shows that the most widely known applications of radiation are "Examination of health conditions and function of human being" (Q9-2) and "Cancer therapy" (Q9-5), as might have been expected. More than 60% of respondents in each country said they knew them. On the other hand, the least known applications are "Microanalysis of harmful pollutants in the air" (Q9-11) and "Production of heat-resistant insulation for electric wires" (Q9-12). Only specialists in radiation might have the full knowledge of these applications and indeed, except for the Philippines and Korea, only fewer than 30% of high-school respondents answered that they knew them. Q9 is not an easy question for lay high-school students to answer. Nonetheless, the Filipinos and the Koreans are found to be ranked as the top two, in terms of the many, highest percentages (figures red-circled) of the respondents who answered they knew these applications. The self-ratings were highest in the Koreans for 6 applications (figures red-circled), and in the Filipinos for 5 applications (figures red-circled). In contrast, the Japanese self-ratings were the lowest among the 7 countries, the percentages of those who answered that they knew these applications being below 30% (figures in light blue) in 8 out of 12 cases.

(10) Identifying Radiation-related Symbols (Logos) (Q10)

i) "Which logo is internationally used to indicate that food was treated by radiation? Please select one from among the four logos."

ii) "Which logo is the radiation warning symbol that is used internationally for indicating existence of materials that emit radiation? Please select one from among the four logos."

Visual Symbols Shown to Respondents

1 2 3 4

Table Q10 Identifying International, Radiation-related Symbols (Logos). Percentage of right answers

COUNTRY / QUESTION	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Ave.	Korea
Q10- ⅰ).Which logo is internationally used to indicate that food was treated by radiation? (right answer: 3)	37.5	43.8	46.8	44.4	52.0	45.4	50.0	29.0
Q10- ⅱ).Which logo is the radiation warning symbol that is used internationally in indicating existence of materials that emit radiation? (right answer: 2)	13.5	63.6	61.9	64.4	71.3	49.3	54.0	—

(NOTE) 1) Figures in the chart show the percentage of right answers (%)
2) : Exceeds 70%
3) : Less than 30%
4) : Highest among the countries
5) Ave. :Mean value of the seven countries.
6) Q10-ii was excluded in Korean survey.

Q10 sought to identify the meaning of international, radiation-related visual symbols (logos). Respondents were asked to answer two sub-questions: "Which logo is internationally used to indicate that food was treated by radiation?" (Q10-i) and "Which logo is the radiation warning symbol that is used internationally in indicating existence of materials that emit radiation?" (Q10-ii). Korea did not ask Q10-ii. The four international visual symbols (logos) shown to respondents are displayed above. The figures in Table Q10 are the percentages of right answers. The highest percentages are red-circled for each sub-question. For Q10-I, the right answer is Visual Symbol 3, while for Q10-ii, the right answer is Visual Symbol 2. It is clearly seen in Table Q10 that the international radiation-warning logo is fairly well known, over 50% of the youth identifying it correctly in each country except China. The radiation-treated-food logo looks more unfamiliar, the correct answer ranging from the lowest 37.5% to the highest 52%. The Thais were ranked the highest regarding the knowledge of the two international radiation-related visual symbols.

(11) Identifying Pictures related to Nuclear Medicine (Q11)

" Please look at the three images shown on the attached sheet. These images are outputs that show applications of "radiation" in the medical field. Please select one Image that would best describe either (i) or (ii) given as follows:

i) Diagnostic image taken by putting materials that emit radiation

ii) Image by X-ray computed tomography (CT) "

Visual Images Shown to Respondents

1

2

3

Table Q11 Identifying Images Related to Nuclear Medicine

Percentage of right answers (%)

QUESTION \ COUNTRY	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Ave.	Korea
Q11- i .Diagnostic image taken by putting materials that emit Radiation (right answer: 1)	30.8	18.3	23.4	29.7	23.1	30.0	25.9	25.0
Q11- ii .Image by X-Ray Computed Tomography (CT) (right answer: 2)	37.2	29.3	51.9	32.4	22.0	24.5	32.9	73.0

(NOTES) 1) Figures in the chart show the percentage of right answers (%

2) : Exceeds 70%

3) : Less than 30%

4) : Highest among the countries

5) Ave. : Mean value of the seven countries.

Q11 is an attempt to identify images related to applications of radiation in nuclear medicine. Students were asked to choose "a diagnostic image taken by putting materials that emit radiation" (Q11-i) and "an image by X-ray computed tomography" (Q11-ii) out of three images shown to them. These images are of the highly professional nature and considered quite difficult for lay high-school respondents to identify. And yet, it will be seen in Table Q11 that, on the average, one out of four lay respondents was able to identify "Image 1" as Scintillation and one out of four was able to identify "Image 2" as CT. Although no immediate explanation is possible, as high as 73% of the Korean respondents were found to identify the image of CT correctly. On the average, the image of CT appears more familiar to the respondents than that of Scintillation.

(12) Students' Specific Interest in Knowing More about Radiation (Q12)

(KEY)

1 Amount of radiation exposure that may affect health of human beings
2 Safety measures in managing radiation exposure
3 Emergency preparedness in radiation-related accidents
4 Facilities that are using radiation
5 Application in food
6 Mutation breeding of crops
7 Applications in industry
8 Applications in the field of medicine
9 Regulation by the government
10 The most advanced fields of research
11 Nothing in particular

Table Q12 Students' Specific Interest in Knowing More about Radiation
"What do you want to know about "radiation"? Please select as many as you like."

COUNTRY	China	Indonesia	Japan	The Philippines	Thailand	Viet Nam	Korea
1	Amount of radiation exposure	Amount of radiation exposure	Emergency preparedness	Amount of radiation exposure	Amount of radiation exposure	Amount of radiation exposure	Medical Applications
	74.7	81.0	56.7	82.9	70.7	89.1	78.8
2	Medical Applications	Medical Applications	Safety measures	Safety measures	Medical Applications	Emergency preparedness	Amount of radiation exposure
	57.2	75.2	55.9	71.7	62.8	73.0	77.2
3	Advanced fields of research	Emergency preparedness	Amount of radiation exposure	Medical Applications	Application in food	Medical Applications	Application in food
	55.6	73.8	48.9	67.0	54.1	70.5	65.0
4	Emergency preparedness	Radiation Facilities	Medical Applications	Radiation Facilities	Safety measures	Safety measures	Emergency preparedness
	52.8	67.6	44.5	64.7	52.6	63.7	62.0
5	Safety measures	Application in food	Advanced fields of research	Emergency preparedness	Emergency preparedness	Advanced fields of research	Regulation
	48.9	66.8	36.1	61.3	48.1	63.1	61.3
6	Radiation Facilities	Advanced fields of research	Application in food	Application in food	Radiation Facilities	Application in food	Advanced fields of research
	48.0	64.3	33.7	59.6	45.2	58.8	58.3
7	Application in food	Safety measures	Radiation Facilities	Advanced fields of research	Applications in industry	Applications in industry	Safety measures
	41.3	64.0	33.2	59.4	45.6	54.8	46.7
8	Mutation breeding	Applications in industry	Regulation	Applications in industry	Regulation	Mutation breeding	Mutation breeding
	35.6	52.9	26.6	51.8	40.7	48.3	44.4
9	Applications in industry	Mutation breeding	Mutation breeding	Mutation breeding	Mutation breeding	Radiation Facilities	Applications in industry
	35.0	47.3	19.6	47.0	34.2	38.9	40.8
10	Regulation	Regulation	Applications in industry	Regulation	Advanced fields of research	Regulation	Radiation Facilities
	26.3	27.9	18.4	37.3	31.8	38.1	35.3

Q12 is a multiple-choice question and sought to tap latent "information need" among respondents regarding radiation-related events. The respondents were asked what they want to know about radiation. The result is shown in Table Q12 in order of the frequencies. Both cross-cultural similarities and cultural uniqueness can be seen in the table. Firstly, in every country, over 70% of the respondents were found interested in knowing about "Amount of radiation exposure" (colored in yellow), probably because they are psychologically concerned over the critical effect of the exposure to radiation. Similarly, the percentage for "Emergency preparedness" (colored in light red) was found high in Indonesia (73.8%), Viet Nam (73.0%), Korea (62%), the Philippines (61.3%), although it was found relatively low in Japan (56.7%), China (52.8%) and Thailand (48.1%). The respondents also wanted to know more about "Safety measures" (colored in orange), particularly in the Philippines (71.7%), Indonesia (64.0%) and Japan (55.9%). Secondly, a large number of respondents (over 70%) wanted to know more about "Medical applications" (colored in light blue) in Korea (78.8%), Indonesia (75.2%) and Viet Nam (70.5%). Thirdly, the interest in "Advanced field of research" was found to vary from country to country, from 64.3% of Indonesia to 31.8% of Thailand. Fourthly, the interest in "Radiation Facilities", "Application in food", "Mutation breeding" (colored in light green), "Applications in industry" and "Regulation" was found to vary from one country to another but generally low in every country. The Japanese in particular appear least interested in those events related to radiation. To enhance their understanding of radiation and radiation-related events among high-school students, it would be necessary to strengthen their motivation by stimulating their curiosity in association with their own life and prospective future career.

EVALUATIVE COMMENTS SUBMITTED BY PUBLIC INFORMATION PROJECT LEADERS ON THE 2002-2003 JOINT CROSS-NATIONAL QUESTIONNAIRE SURVEY

(1) Has there been any opportunity in your country that the results of the joint cross-national survey were published or publicized in some way?

JAPAN

1) In terms of a "feedback", high-school teachers who previously assisted data collection reported the result of the joint survey to their classes, including those who had served as respondents. The teachers observed that the students were very much interested in cross-national comparisons.

2) Based upon the result of the survey, Dr. Sueo Machi, Japanese FNCA Coordinator had opportunities to visit Aizu Industrial High-School, one of the collaborators for the survey, in February 2003, and gave a talk to students regarding cross-national similarities and differences in the extent of knowledge of modern science and the perception of radiation such as food irradiation, radiation breeding, medical equipment sterilization, and so on. He also referred to nuclear power generation emphasizing its importance as stable energy source and for global environment preservation. About eighty students participated in the lecture and deepened knowledge and understanding about radiation.

3) In September 2003, upon the request made by the Japanese FNCA Secretariat, the Atomic Energy Society of Japan (AESJ) provided an opportunity for the Japanese FNCA Public Information Working Group members to organize a special panel session during its semi-annual meeting. The session was chaired by Japanese Project Leader, Professor Emeritus Yasumasa Tanaka of Gakushuin University. Two papers were presented regarding the result of comparative quantitative analyses of the cross-national survey data, and two outside discussants were invited to comment on the survey results. The session attracted more than 150 audiences.

4) In July 2003, a member of the Japanese FNCA Public Information Working Group, Prof. Shinji Okamoto of the Center for Joint Research, Shizuoka University, presented a paper based on the joint survey, at the annual meeting of Japan Society for Science Education (JSSE). His presentation was entitled "International Comparison of High-school Student's Attitudes and Understanding of Radiation in Asian Countries".

5) Also, in September 2003, a special issue of the FNCA Newsletter (in Japanese) was published, summarizing the major findings of the joint survey. This special issue of the FNCA Newsletter served for publicizing the achievement of the FNCA Public Information Project for a wide range of the audience.

6) In March 2004, the 14th Pacific-Basin Nuclear Conference (PBNC) was held in Honolulu, Hawaii. Three special panel sessions were convened regarding Public Information and Outreach activities in the Pacific-Basin. Professor Yasumasa Tanaka, co-convened these special panel sessions and co-chaired one session. In the session he co-chaired, he presented a paper entitled "A cross-national Study of Science Literacy and Perception of Radiation in Seven FNCA Countries."

7) In August 2004, the Third International Symposium on Radiation Education (ISRE 04) was held in Nagasaki, Professor Tanaka was invited to give a talk in a plenary session regarding "A Cross-cultural study on Science Literacy and Perception of Radiation in Seven Member Countries of the FNCA".

8) In addition, three copies of the Interim Report prepared in Japanese by Asia Cooperation Center of the Japan Atomic Industrial Forum, Inc. (ACC/JAIF) were submitted to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) as achievement of the FNCA Public Information Project for the FY 2002-2003.

Korea

Dr. Kyoung-Pyo KIM
Project Manager
Principal Researcher
Korea Atomic Energy Research Institute (KAERI)

Conclusions and recommendations to be made at the forthcoming ministerial meeting concerning the final report of the "Joint Opinion Survey on the use of radiation with the target of

students of high schools" will be utilized and reflected to enhance the nuclear related knowledge of students in Korea.

The Philippines

Ms. Rhodora R. Leonin
Head
Information Service Unit
Philippine Nuclear Research Institute (PNRI)

1) The Philippine PI Project Leader made a presentation on the results of the joint survey during one of the Parallel Sessions of the 2004 Asia - Pacific Physics Teachers and Educators Association (APPTEA) National Convention. The annual convention was held at the University of the Philippines - National Institute for Science and Mathematics Education Development (UPNISMED) in Quezon City on April 16, 2004. The session where the survey results had been presented was attended by around 30 Physics teachers. The various public information activities being conducted by the Philippine Nuclear Research Institute (PNRI) were also presented in this session. Presentations regarding the joint survey and PNRI's public information activities on nuclear energy will be made in other physics teachers and educators conventions in coordination with UPNISMED.

2) Some of the results of the joint survey were discussed with or presented to teachers and students who came to the PNRI for lectures and guided tours of PNRI facilities and laboratories. The results were also mentioned during the conduct of nuclear awareness seminars in schools.

3) Four copies of the joint survey were provided to the Director of the Department of Education-National Capital Region (DepEd-NCR) and to the Science Supervisors of the DepEd-NCR who assisted the PNRI in the selection of the schools which were surveyed. The results of the survey will be presented by the PI Project Leader to science supervisors and science teachers of the National Capital Region (Metro Manila).

4) Copies of the survey were also provided to the schools that were surveyed, through the DepEd Secondary Schools Division.

5) A copy of the joint survey was given to the Physics Department of the UPNISMED for use as basis in the development of instructional materials for teachers and in the preparation of Physics textbooks for students.

Thailand

Mr. Vidhaya Rajatatibodee
Head, Public Relations Section
Office of Atoms for Peace (OAP)

The Office of Atoms for Peace (OAP) is now underway of building Ongkharak Nuclear Research Center (ONRC) in Nakornnayok Province. So, we have continuously held so many training courses to give nuclear information to teachers and students in Nakornnayok Province. It was a pity that last year we did not hold any course there because there were some problems. Nevertheless, anybody who takes interest in nuclear information can search our Website.

We found that science curriculum in school (both primary and secondary schools) should be improved, especially nuclear field should be more added. Technical Council is the body of OAP who handles this matter. On July 22, 2004, their staff had an opportunity to discuss with representatives of Ministry of Education and there was a conclusion that the Working Group had to be set up.

Viet Nam

Ms. Dang Thi Hong
Senior Expert
Department of International Relations and Planning
Vietnam Atomic Energy Commission (VAEC)

Joint survey of understanding and interest in radiation among high school students in Viet Nam was carried out in Viet Duc High School, Hanoi in 2002 under framework of the FNCA PI project activities in FY2002. Results of the survey have given a preliminary estimation of understanding and interests of Vietnamese high school students about radiation. Survey results have not been published yet in Viet Nam but based on the results,

radiation item should be considered to introduce in high school textbook in the near future.

(2) What is your evaluation of the joint survey? Please state your evaluation for each item given below.

1) What in your opinion is the practical value of such a joint survey?

Indonesia

Mr. Adiwardoyo
Director
Center for Public Information of Nuclear Science and Technology and Cooperation (PPINK)
National Nuclear Energy Agency (BATAN)

The Advantages of the Cross-national Comparative Survey for Public Information and Education in Indonesia

a. It can be concluded in general that the implementation of cross-national comparative survey has been successfully conducted. The teachers and students were very cooperative and interested as well as having expectations for a follow up based on the cross-national comparative survey. The National Nuclear Energy Agency (BATAN) realized from the survey that it should provide educational material that can be used by the teachers to teach a unit on radiation safety to their students. It would be useful to provide samples of audiovisual materials that would be suitable for such classes. We hope that through FNCA project leaders meeting, such exchanges of audiovisual materials could also be conducted.
b. The results of cross-national comparative survey are very useful because it shown the direction for developing public information and education programs on nuclear science and technology to increase the understanding and positive perception of the people (especially teachers and students) regarding the benefit of nuclear science and technology.
c. In line with the cross-national comparative survey, BATAN on a periodic basis conducts lectures and seminars for high school teachers and students. The objective is to increase the level of knowledge and understanding of the teachers and students toward nuclear science and technology and its beneficial use.
d. BATAN in cooperation with the Department of National Education conduct science competitions for high school students and the results are very useful in promoting nuclear science as a subject in high school education curriculum. Thanks to the results of the cross-national comparative survey, this activity has been greatly enhanced.

JAPAN

The practical value of the survey is twofold in the Japanese case. First, in a general model of communication process, the effect of communication is significantly affected by the message sender, the message itself, the channel (or the media) and the message receiver. In order to make the content of message meaningful, the sender must know in advance the interest, attitudes and beliefs of the receiver. What is usually called the “audience analysis” is a necessary condition and an effective social-scientific tool by means of which the sender can get information about the targeted audience as a preliminary necessary step to produce an effective communication content. In the Japanese case, the “representative” audience examined were a total of some 1100 male and female high-school students. Much could be learned of the psychological characteristics of the audience in 7 FNCA countries. Secondly, within the context of cross-national comparisons and observations, the mutual or reciprocal exchange of information between and among the Project Leaders of participating countries itself provided excellent opportunities for a better understanding of the own and the other culture and people vis-à-vis the science and radiation. It is hoped that, on the basis of the results obtained, an up-to-date content of information in the science education may be assessed and recommended in each country.

Korea

It is noted that the nuclear related knowledge of the respondents and their attributes could be

analyzed and compared with other countries in Asia through the joint cross-nation survey under the framework of the FNCA PI project. The results of the survey in Korea will be useful for revising and enhancing the educational programs for the promotion of a better public understanding on nuclear energy.

The Philippines

Although this survey cannot be used as generalizations for high school students in any particular country, it nevertheless provides valuable and interesting information that can be very useful in improving the learning and understanding of students of radiation and science concepts. The survey provided information on the students' sources of information which can be used as reference or basis for developing appropriate information, education and communication (LEC) materials that are aligned with the students' major sources of information on science and technology. Other sources which ranked low in the choices can also be improved so that the interest and understanding of radiation and science concepts will be increased. The result of the joint survey also provides confirmation/ justification for pursuing or re-emphasizing activities that can significantly contribute to the students' understanding and interest of the subject matter. In the Philippines, these activities include the training of science teachers (especially those who are teaching Chemistry and Physics) in order to equip them with adequate, relevant and updated skills and knowledge on effective and competent teaching of radiation and science concepts. (In this joint survey, the Philippines had the highest percentage of respondents who rely on teachers as source of information on science and technology, hence the need to train/ and also educate teachers).

Thailand

The Practical Value of this survey is, there is the comparison of information among each country. Information from one country can be an example to others. This will help to develop each country in many fields, especially in the field of education.

Viet Nam

Joint survey is one of the FNCA PI activities in 2002. The survey results about high school students in Viet Nam indicated the preliminary estimation about knowledge and understanding of high school students on radiation. High school students in particularly and young generation in general, are main objects of PI activities on nuclear energy. Based on level and knowledge of students, it is easy to find suitable way to provide information. From survey results, we know that television, radio, magazine, teacher is main sources of information for students. Then we have a plan to improve the cooperation with mass media.

2) *What in your opinion are the unique responses by the students in your country?*

JAPAN

First, the Japanese youths do not read books and magazines as the sources of information about science and technology, in comparison with their counterparts in other countries. The percentage is the lowest among the 8 countries examined. The Japanese are more TV-watchers.

Secondly, despite a national aspiration that Japan should be a top IT nation in Asia, more students in other counties than the Japanese tend to use the Internet as a tool by means of which they acquire scientific information. The percentage is the lowest again for the Japanese.

Third, a fairly large number of Japanese students are found to rely on comic books as a source of information about science and technology.

Fourth, the percentages of those who utilize interpersonal communications between teachers and students and those in the peer groups appear to be among the lowest for the Japanese. The Japanese youths do not talk about science and technology either with their friends or with their teachers, relative to students in other countries.

Finally, Japanese students' interest in the public affairs, such as science and technology, energy and environment, politics and economy were found the lowest among the 8 countries examined.

On the other hand, their concerns in their own future, personal relations with friends, and culture and sports are very strong. Generally speaking, it appears that the Japanese students tend to be more interested in immediate and tangible things

and detach themselves from remote and abstract things, in comparison with the students in other countries. This happens probably because of the general traits in the educational and cultural environment. Such information regarding the uniqueness of the Japanese responses may be valuable for Japanese high-school teachers.

Korea

The survey showed that the students in Korea had more interest in the entertainment business or other fashion activities rather than thinking about the use of nuclear energy. They recognized the need of electricity to turn the motors of the manufacturing plants and to supply power to their computers. They understand that nuclear power has been playing a significant role in supplying the electricity. But, they expressed reservations about the nation's nuclear power program. Meanwhile, a lot of students understood the benefits that radiation would give. However, they were also afraid of being affected by radiation. Such a perception has not been improved. If there were to have another similar survey, the results would be almost the same.

The Philippines

a. A larger percentage of Philippine respondents, as compared to other countries, rely on the Internet as source of information on science and technology. This may be partly attributed to the ease in accessing/retrieving information on the Internet and due to the accessibility and proliferation of Internet Cafes in the capital city.
b. The Philippines had also the highest percentage of respondents who rely on school teachers as source of information on science and technology. This result may be considered as a strong indication of a teacher-centered classroom in majority of the Philippine schools surveyed.
c. A fairly large percentage of the Philippine respondents, next to Indonesia, also use school textbooks as source of information on science and technology.
d. As compared to other countries, more students in the Philippines rely on exhibits, fairs and seminars as source of information on science and technology. The result may be partly attributed to their exposure to these sources during the National Science Club Month celebration scheduled every September in their schools. The celebration encourages schools to hold/arrange seminars, set-up exhibits or invite exhibitors in their schools or visit scientific institutions, among others. The result may also be partly due to the participation of schools the Annual INTEL Science Fair in the Philippines. Winners of the fair have the opportunity to participate and compete in the International and Engineering Fair sponsored by INTEL. A number of Philippine students have won in this international competition.
e. A very high percentage of Philippine respondents associate radiation with the word "Familiar" as compared with other countries. This may be associated/ correlated with the following:

(a) Item F7 in which the Philippines has the highest percentage of family members or acquaintance treated with radiation, and
(b) Item F4 in which the Philippine ranked second highest among the seven countries having been taught about "radiation" or "radioactivity" at school.

Thailand

Thai students still have no self-confident. This can be seen from the result of the questionnaire. When compare to other country, Thai students are in average. On the other hand, if they used to be trained or got the information from OAP, such as the knowledge about radiation LOGO, they can show off their knowledge and can easily answer the question.

Viet Nam

a. Almost of Vietnamese high school students interest in their future life (67.9%) and politics and economic (48%). About 35% of Vietnamese students interest in Medical Care and Health, Culture and Sports, and Science and Technology.
b. Main sources of information about science and technology for Vietnamese students are television, radio, magazine and science books. Role of teachers and textbooks is not so high. In Vietnam now, understanding and knowledge of high school teachers on science and technology are limited.
c. From 75-85% of high school students have answered correctly all questions on science and technology. About 77% of high school students

concern about radiation topic, but only 63% among them understand somewhat about radiation and 30% don't understand it at all.

d. Vietnamese students know well about radiation application in the fields of Health Care, Agriculture, Industry, Food Irradiation and Nuclear Power Generation. Almost of them think that radiation is useful, promising, controllable but very dangerous.
e. Vietnamese students would like to know more about radiation such as: amount of radiation exposure that may affect health of human being, safety measures in management of radiation exposure and how to solve when nuclear accidents happen, etc. They would like also to know about application of radiation in cancer therapy, mutation breeding as well as in other advanced technologies.
f. About 80% of Vietnamese students would like to have science courses in their school.

3) What are the findings which you find most interested in the cross-national comparisons?

JAPAN

To exemplify only a few, first with regard to association with radiation, it was surprising to find more than 70％ of the respondents associate “Hiroshima and Nagasaki (Nuclear Weapons)” with “radiation” in 4 out of the 6 countries. The memory of Hiroshima and Nagasaki had been thought of previously as unique to the Japanese. Contrary to this expectation, a legacy of World War II appears to remain strongly among the youths in the Asian countries as well. Secondly, more than 70％ of the respondents associated “Nuclear Power Generation” with “radiation” in 4 out of the 6 countries. Although only Japan, China and Korea are nuclear power generating countries, the knowledge that radiation is a unique characteristic of nuclear power generation seems universal everywhere. Thirdly, it was also intriguing to discover that, except for Korea, most respondents in 6 countries think that the characteristics of “natural” radiation are different from those of “artificial” radiation. This misconception may have accrued from insufficient information about radiation in each country. More information may have to be given to the youths about the nature and usefulness of radiation in classes as well as in textbooks in each country.

Korea

It was observed that the Korean students of the high schools had almost the same views as in the Japanese case in terms of their perception of radiation and the interested fields, while they were different from the cases of China and Vietnam. Concerns about radioactive waste have been expressed by the Korean students, while Japanese students have shown a sensitive response to accidents in nuclear power plants. It means that the common interest of both two countries is safety. It is, therefore, recommended that a survey on security matters together with safety be implemented in the future.

The Philippines

a. Although there are no nuclear power plants in the Philippines, a little over 80 percent of the Philippine students responded to “Nuclear Power Generation” (the highest figure among all countries) to the question “What radiation brings to mind?” This may be due to the extensive media publicity that has been generated by the Bataan Nuclear Power Plant (BNPP). Many science (specifically physics) textbooks also mention the BNPP on discussion/topic about nuclear energy.
b. Like Japan, we also find it intriguing that, except for Korea, most respondents in other countries think that the characteristics of “natural” radiation are different from those of “artificial” radiation. A perusal of some of the Philippine textbooks used in the secondary (high school) level showed that this information is not described in the textbooks. This result suggests that more information on the nature and characteristics of radiation have to be provided to students in classes and in textbooks, among others.
c. Although the topic on determining the sex of a child is discussed in Biology textbooks, the Philippine respondents obtained the lowest percentage of right answers among the participating countries. This result may be partly attributed to the way the topic was discussed in the high school textbooks. A

perusal of some of the Biology textbooks used in schools showed that there is no statement that directly states that the sex of a child is determined by genes of a father. Rather, sex determination is described in terms of pairing of X and Y-chromosomes.

Thailand

The most intriguing is that students in most FNCA countries are quite in the same level of getting to learn the basic nuclear knowledge.

Viet Nam

a. Vietnamese high school students more interest in Politics and Economic than in other countries.
b. Television and radio are main sources of information for students in all countries.
c. Almost of students in each country do not understand well about radiation but they know some its useful applications in Health Care, Agriculture, Industry, Food Irradiation, and Nuclear Power Generation.

4) What is your overall evaluation of this joint survey?

JAPAN

First, the survey project was a good success as the first collaborative undertaking by the 7 FNCA countries. Second, the results clearly showed a varying degree of knowledge about science, technology, and radiation, probably because of differences in priority teaching in each country. Third, the survey also served to discover the interest, attitudes and value judgment of the high-school students regarding science and radiation in each country. The obtained information provided a good basis for selecting a better and more appropriate communication content to be addressed to the high-school student audience and more effective channels of communication by means of which the communicators can reach the audience. One cannot expect to get all information one might wish to get by a single study. Only repetitions of research and accumulated results will enable one to have a clear, objective and accurate view of the state of affairs one wish to examine.

Korea

Every Member Country has different social cultures, economic and political situations and religions as well as infrastructures, nuclear technology, etc. It is observed that the contents of the questionnaire of the joint cross-nation survey would better serve the Member Countries by being more focused on each country's attributes and characteristics. It is, therefore, desirable that appropriate contents for the questionnaire be developed if another joint survey towards other groups is planned.

The Philippines

The joint survey is a very important undertaking of FNCA countries. The survey generated very useful and interesting results. It provided an overview on the interest, preferences, knowledge, and understanding of high school students (who have different educational systems, curricula and cultures) on radiation, and science concepts. It also showed the similarities/ common patterns as well as misconceptions/ misinformation of students. The information obtained from the results of the joint survey will be very useful in terms of the following:

a. Assessment and selection of information/ content that can be provided to the students and teachers, and
b. Selection and development of more appropriate information, education and communication materials/ tools that would cater to the needs and interests of the students in participating countries.

Thailand

Since each country normally does their survey of their own, this joint survey will help FNCA countries in getting to know the information and result of other countries' survey. No significant difference between the surveys of each country.

Viet Nam

a. Joint survey on knowledge and understanding of high school students about radiation in 7 countries of FNCA is the first PI survey in FNCA PI activities. It is very useful for each country to know about knowledge of local students about science and technology. Based on these results, we could find the best measure to provide information about science and technology to students.
b. Public information is one of the most important activities in nuclear program of each country use nuclear power or attends to introduce nuclear

power. To understand well objectives of public information activities, the surveys like this are very necessary and should be conducted usually.

Australia 

Mr. Craig Pearce

Manager
Corporate Communications
Australian Nuclear Science and Technology Organisation (ANSTO)

Overview

Undertaking cross-cultural surveys provides insight into the way in which residents of different countries perceive issues and process information. It can also enlighten communicators as to the mechanisms that impact on knowledge, perceptions and behavior. This is particularly useful for organizations that operate in multiple cultures at any one time and need to adapt not just communication strategies and tactics, but also organize the administrative 'back-end' that drives this communication.

The FNCA is not a commercial enterprise and so these factors are not necessarily useful to it in this context. However, due to the collaboration between FNCA members and the knowledge sharing that the organization facilitates there is, in fact, a notable underpinning reason why the 2002 cross cultural survey under discussion here may prove useful to FNCA members and their constituents.

This is that due to the FNCA's knowledge-sharing approach, the base information revealed by the survey provides a context that may assist its members in determining whether communication successes (or failures, for that matter) in one country are likely to be duplicated in a different culture.

Another benefit of the research is that it increases knowledge of and understanding between cultures in the Asian region. This is perhaps particularly important for Australia, as its role and profile in the region, politically and economically, has the potential to increase in future years.

Effective communication is not, in theory, as complex as the nuclear technology which FNCA members are dedicated to communicating effectively about. In practice, however, all communicators, no matter what field they operate within, are aware of just how difficult it is to communicate with their stakeholders. 'With' is a key word in this context. The best communicators seek to identify the interests of stakeholders and act as a facilitating mechanism so that the stakeholders influence the attitudes and behavior of their employer, as much as the employer or organization seeks to influence the stakeholders.

In nuclear communication – whether it is on behalf of one related to nuclear power or nuclear science and technology (such as ANSTO) – the relevance and importance of this approach is more apparent than in most sectors. This is due to connotations the word 'nuclear' carries in some stakeholders' minds, certainly, but more to the point it is because community perception as well as political and regulatory factors (the three often being virtually inseparable) impact more heavily on the nuclear industry than most other. To successfully operate to its potential, the nuclear industry must pay heed to stakeholder needs and wants and incorporate them into its operating practices – not as an add-on, but as an intrinsic part of its processes.

This argument is supported by Professors Lee Preston, Sybille Sachs and James Post in their book, *Redefining the Corporation: Stakeholder Management and Organizational Wealth*. They say that organizational wealth is increasingly attributable to what they term 'soft forms' of capital: reputation, trust, good will, image. They state that:

'The wealth of the corporation is not merely the property it owns, the financial resources it accumulates, or even the intellectual property it develops. The corporation's most important asset – and the only one it cannot create or replace on its own – is its acceptance within society as a legitimate institution.'

Sir Arvi Parbo said as much when saying, 'We can do our sums, be great at production and marketing, fine tune our cash flows, manage people – we can do all those things well but fail badly if we haven't managed the social and political issues.'

It is not, in this writer's opinion, overly

necessary to have a particular expertise in either science or nuclear issues to be an effective communicator for the nuclear industry. Of course, it is necessary to have insight into what one is communicating about, but it is more important to be sensitive to relevant issues and be aware of salient influencing factors and effective communication mechanisms. It is also vital that the communication practitioner is well versed in utilizing appropriate communication tools and has adequate resources at their disposal. It can, in fact, be beneficial to bring a non industry-specific background to the communicator's function. This can introduce a fresh perspective to communication activities, a different set of skills or perhaps a new rigor. There is a risk that by working in any one industry for an extended period that a communicator's skills can atrophy. What is needed in the nuclear industry is a constant dynamism and freshness. If this cannot be achieved by working outside the industry then it should certainly be achieved by education, shared experiences with both nuclear and non-nuclear communicators and an attitude that demands and fosters high standards and best practice.

School Education

Not being aware of the drivers behind undertaking of the FNCA survey, it is interesting to note that it focused on high school students. The sub-text of this is that it was perceived the perceptions of young people were important to the nuclear industry, even though these people cannot vote, are likely to be less politically opinionated than adults and are not financially independent. The immediate impact, therefore, that survey subjects could have on the operating practices of nuclear organizations in FNCA countries is likely to be very limited.

Like its fellow FNCA members, ANSTO likewise considers the education of young people on nuclear issues as being important. They are future decision makers for, ultimately, nuclear organizations. They can choose to vote for politicians that are in favor of or opposed to nuclear. They can fund and join organizations opposed to nuclear power and/or science. They can, in fact, influence their parents and other people on nuclear issues. For evidence of the potency of young people in the latter regard, one only has to observe how much money is invested into children's advertising, based in the belief that can get their parents to buy certain foods, clothes, and even cars and holidays perhaps!

In most cases, the context in which communication takes place is an integral influencing factor on its success. Communicating on scientific issues is a challenge because they often require reflection and thought to be effectively processed. Therefore, quick television 'hits' or 'sound bites' will not generally do the topic justice or communicate clearly the issues involved. The context of a class dedicated to teaching science provides an environment in which communication participants are primed to receive and process scientific information, underlying the potential worth of investing into science education in schools.

Furthermore, adults have often already formed their opinions and it is difficult to change these once in place. By getting in early, nuclear communicators can present their case for consideration by its constituents and it can be processed accordingly.

Market Research ANSTO undertook in the latter part of 2003 found that 88% of the Australian community agreed that *education through secondary schools is an effective way for people to learn things that remain with them for a long time*. Also, in the same survey it was identified that 93% of ANSTO staff, 92% of government and 93% of business stakeholders felt that nuclear science should be taught in schools.

With this in mind, ANSTO has developed an education resource for the Year 7-10 (roughly, 12-16 year olds) Science subject taught across the whole of Australia. It is called *Nuclear Science in Society*. The resource is relevant to each of the different Australian state and territory curriculums, and its primary source of distribution is through the website www.ansto.gov.au/edu

Alliances and sponsorships with science teaching associations, presentations/ workshops at science teacher conferences, editorial and advertising in science teacher publications, awareness raising through science units of education departments and other activities are part of its supporting promotional strategy.

It should be noted that a key philosophical approach underpinning the construction of ANSTO's education resource is that alternative, often oppositional voices, to nuclear science and technology should be recognized and represented.

Not to do so would undermine the credibility of the resource in teachers' eyes. As teachers are the gatekeepers of this information (essentially the materials are targeted towards them in the sense that they are the ones applying the resource), and are characteristically cynical towards privately sponsored education materials (they are expected to be protective towards their students), it was imperative this approach was taken. More importantly, from an organizational cultural perspective, it is important that ANSTO, whilst strongly believing in the benefits of its research and commercial activities to Australian people and the international community, recognizes and respects that there are other perspectives on its operations and the nuclear industry as a whole.

It is planned to periodically update this information and to keep promoting it.

Specific Research Comments

- The dominance of television as an influencing factor is similar to that of Australia as an awareness-generating factor
- Putting television and radio into the same question undermines the potency of the findings; it would have been more useful for the two mediums to be separated in this survey
- The relatively high proportion of survey respondents who identified the internet as a source of information on science and technology is indicative of the rising importance of this communication medium. It will be interesting to see whether the influence of this medium increases in future years
- It would be useful to compare the FNCA cross-cultural research with that undertaken in different countries by specific FNCA members that may perhaps be focused in complementary areas. This may provide further insight into issues the FNCA research has identified but not deeply explored.

(3) Do you have any thought about the future undertaking of another PI survey?

Indonesia

a. Experience in recent years has shown that teachers and students also play a vital role in spreading information to the public; therefore their involvement in public information and education activities is very important. Therefore to evaluate the results of the cross-national survey, teachers and student involvement is needed. In connection to that BATAN shall prepare programs in that regard. For future programs, the homepage will be utilized for spreading the results of cross-national comparative survey, so that inputs and comments from the teachers and students could be collected and evaluated properly.
b. For future Public Information activities, it is advisable to provide special communication training to management and selected staff in order to familiarize them with methods of communication. The learning objectives of such training are:

First, to obtain a general overview of the strategic planning and implementation of public relations.

Secondly, to improve presentation and communication skills for interaction with the news media.

Third, to prepare for communication with the news media and the public in the event of an emergency, close coordination with national and international organization is also important.

JAPAN

First, in accordance with a general theory of communication, research on the audience is a necessary condition for an effective communication. It has been known in communication research as well as in advertising that the audience is not a monolith but divided into a number of segments, such as male and female, age groups, different locations of residence, or professions. In most nuclear power generating countries, such as the United States, Canada, UK, and France, periodic surveys are carried out to tap the attitudes of the segmented populace toward the government's energy and environmental policies, the nuclear and other sources of energy, and the information need of the people. From this point of view, no effective communication is possible without knowing about the psychological characteristics of segmented audiences. Communication, which involves both public information and outreach activities, is a key factor for reaching the audience to enhance public acceptance.

Second, it should be recognized that the acquisition and training of the human resource---that is, the communicator---pose serious problems in the nuclear profession. In

the medical and pharmaceutical professions, doctors and pharmacists are trained therapeutic communicators. No such training is present in the nuclear profession. Research on the segmented audiences in a given country should profit prospective nuclear communicators, because without the measurement of attitudes, opinions and affects held by the audience, no communicator could produce appropriate and sensible messages to the audience.

Finally, it appears self-evident that some special training program will be needed for the nuclear communicators or spokespersons whose major role is to communicate with the mass media and the populace from time to time, smoothly and effectively. To the extent that knowledge is power, knowledge about the targeted audience should serve for enhancing the insight and ability of nuclear communicators and spokespersons to handle the communication problems with the media and the people more successfully.

Korea

The need to promote a better understanding about nuclear energy to women is ever increasing. Considering the fact that half of the target audience is women and acceptance by women, particularly housewives, plays an important role in carrying out nuclear programs without any difficulties, special attention should be given to information programs for women. In this regard, further survey is recommended towards women including house wives.

An analysis of trends is indispensable for successful opinion poll. The more trends of perception have been evaluated and analyzed, the more effective strategy for promotion of nuclear energy could be established. Therefore, continuous joint surveys for several years rather than a single survey should be carried out.

The Philippines

a. Using the same joint survey questionnaire, participating countries can conduct another survey using a random sampling of respondents. This is to be able to use the results as generalizations for high schools students in participating countries and thus, make the cross-national comparison more meaningful.
b. An attitude/ opinion survey on nuclear energy and related issues such as nuclear safety and nuclear wastes could be another joint undertaking. This is to determine the underlying reasons/ factors, for example, why “Dangerous” was selected by more that 70 percent of the respondents in the seven countries as their image of radiation.
c. Results of the joint survey (Item 1) and the suggested attitude survey (Item 2) could be used to correlate attitude with extent of understanding and interest on nuclear energy and science concepts.
d. A survey on understanding, interest and attitude in radiation/ nuclear energy among high school science teachers could also be conducted to determine the scope of knowledge and understanding of the educators regarding concepts on radiation and science.

Thailand

The target of this joint survey was secondary school level. Primary school level should also be included in the survey. The questionnaire should be improved which will be more benefit and will show more differences between countries. This may depend on the basis or level of the education of each country’s students. This will be the main result for developing their own country to strengthen the competitiveness to other countries.

Australia

Future Research

In future, it would be useful to identify what factors and mechanisms influence school students’ knowledge, perceptions and behavior on nuclear issues. The survey under discussion had more of a focus on what students knew about radiation and what communication activities relevant to science and nuclear issues they had been involved in.

It would be useful to undertake a joint communication initiative across all FNCA member cultures on a specific communication tactic. An e-magazine, similar to the one ANSTO has developed (http//:ansto.velocity.gov.au), translated into different languages is an example of this. Another is the quarterly direct mail news flash device ANSTO has developed. The effectiveness of this tactic could be measured across all cultures and provide a specific example of the impact cultural differences have on communication activities. From a practical perspective, it may

mean less resource need to be expended on conceptualizing and developing resources if components of these resources can be duplicated to some degree.

It could be argued that the predominantly Anglo-Saxon culture of Australia would provide a useful comparative point to the cultures surveyed in the 2002 report. It is hoped that in future Australia can be included in surveys such as the one in question to provide insight into this question. Whilst it is currently illegal under Australian Government policy to have nuclear power (in Australia), nuclear science and technology is an important part of the country's diverse scientific expertise. Also, nuclear power as an issue is increasingly being discussed as an option whereas previously it has been discounted by many, due in part to the increasing awareness of and concern towards climate change, greenhouse emissions and the Kyoto Protocols. There is therefore likely to be current and future use for further research undertaken into nuclear issues in Australia.

Summary

It is a useful exercise to share information related to communication activities undertaken by nuclear organisations across various cultures. The survey provided a useful exploratory and benchmarking exercise. It will be worthwhile to initiate an expanded survey within the next two years that both calibrates changes in issues flagged in the 2002 research, and extends it into specific areas that may be of practical use to FNCA members.

(4) Additional comments, if any

Korea

Due to the topsy-turvy Dom values on materialism and industrialism, younger generations demonstrate different perceptions of the nuclear industry. An appropriate educational program for correct values will be able to provide the future generations with a reasonable understanding of nuclear energy. It is also recommended that a draft of the results of the joint cross-nation survey be posted on the PI web site as an outstanding outcome of the PI project.

The Philippines

a. The joint survey results showed that students from most countries rely on television, radio and newspapers as sources of information on science and technology. These results re-emphasize the crucial role that the media plays not only in disseminating information to the public but also in influencing opinions and attitude of the public towards a specific issue. It also suggests the need to broaden the knowledge and understanding of the media on radiation/ nuclear energy and science concepts so that they will be able to disseminate reliable and accurate information to the public. Journalists, TV/ radio broadcasters, program scriptwriters and science writers could be better informed about radiation and nuclear energy applications through participation in regional seminars and workshops in which they could have hands-on experience of measuring background radiation, visit radiation and nuclear facilities, etc. The topics in the seminars/ workshops should be discussed in a simplified non-technical language.
b. The support of the Department of Education and other agencies involved in science curriculum planning and development is very important in the successful implementation of a country's information, education and communication activities. Hence in the Philippines, the PNRI is exerting efforts to expand, strengthen and sustain its linkage with the said agencies to be able to promote a better understanding of radiation and nuclear energy applications to students and educators. The FNCA could be of great help in enhancing knowledge/ understanding and interest of educators and science curriculum planners/ developers on radiation and nuclear energy applications by providing them with opportunities to participate in regional seminars and workshops in which they could have first hand knowledge about radiation/ nuclear energy topics, hands-on experience of measuring background radiation, and visit radiation and nuclear facilities in FNCA countries.

POSTSCRIPT

Note from Public Information Project Leader of Japan

"Nuclear Communication as a Science and an Art"

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Within the FNCA framework, Public-Information Project is most unique in that the objective is to enhance the understanding, acceptance and promotion of use of radiation- and nuclear-related events and objects for the benefit of each participating country. The major tool for attaining this objective is communication.

Public-Information Project thus always deal with humans and their communication process. In a bird's-eye view, the Public-Information Project covers a wide area of communication activities, such as FNCA Newsletter, FNCA Website, Regional Speakers Bureau, Training of Nuclear Communicators, and Communicating to Journalists and the Mass Media. All these activities involve a complex communication process, which consist of the Sender, the Receiver, the Message, the Media and the Effect of Communication.

Remember a simulated TV interview which was aimed at training competent nuclear communicators during the Public Information Project Leaders' Meeting held in Thailand in October 2004? Each participant was assigned to play a specific role (ranging from Director of Research Institute, the Mayor or a Violent Demonstrator) before real TV cameras and later saw by way of playing back the video tape how he or she had behaved before the TV cameras and was told by the instructor what possible impressions (effects) he or she might have given the viewers by what he or she had said and how he or she had behaved before the TV cameras. The message was not only the word. It also was a facial expression. It also was a gesture. It also was a tone of voice. It also was even a pause or a silence. To be a competent nuclear communicator, one must first learn what communication is and how one can communicate with others.

In the last three-year period, a cross-national survey was carried out to examine the literacy and the awareness of 1000 male and female high-school students in seven FNCA countries regarding science and technology and use of radiation. The findings were highly evaluated by everyone concerned. The result of the survey may soon be published in the FNCA Website. Based on the general agreement reached at the previous Public Information Project Leaders meetings, a new cross-natural survey may be launched in the next three-year period, although the detail of the scheme is still to be discussed and agreed upon at the forthcoming Project Leaders meeting.

A cross-national survey, such as these, helps understand the attitude and awareness of the targeted segment of the populace in each country. Without the prior knowledge obtained from a survey of what people in the targeted segment know, think and feel, no effective communication strategy could possibly be derived. Furthermore, without information obtained from a survey of what people in the targeted segment know, think and feel, no precise assessment of the effect of the past education and public information outreach could possible be made. Without knowing about the audience, there would be no intelligent way of encoding an effective message to the audience.

Communication is both a science and an art. As a science, it is based upon the theory and methodology of communication derived in the social- and behavioral- science disciplines, such as social psychology, psycholinguistics, political communication, sociology, semantics, and more generally, communications research. Literature abounds in these disciplines. Any competent nuclear communicator should not ignore the theory and methodology of communication. Communication also is an art, however. Science cannot move people but arts can. The fine arts, the music, the dramas, the novels, all these appeal to emotions. Trust and distrust, love and hatred, acceptance and rejection, all these are emotional responses. The effectiveness of communication relies not only on logic but on emotions. It relies more on emotions than on logic in an intense, conflict situation. Any competent nuclear communicator, therefore, should not ignore the important role of emotions played in the communication process. In this respect, future nuclear communicators may be profited by learning lessons from other industrial sectors, such as the automobile and apparel industries, which are used to daily interactive communications with the customers and have accumulated in their respective industry the insight, methods and skills to handle the professional communications, such as those related to the audience (market) analysis and the message (content) encoding.

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