東京大学
THE UNIVERSITY OF TOKYO

IAEA Technical Cooperation Programme

国立研究開発法人
日本原子力研究開発機構
Japan Atomic Energy Agency

IAEA INTERNATIONAL WORKSHOP

Regional Training for Teachers to Introduce Nuclear Sciences in Secondary Schools through Innovative Approaches

TTWS JPN 2019

For the IAEA Technical Cooperation Project, RAS00079
Educating Secondary School Students and Techers
on Nuclear Science and Technology

18 February to 1 March 2019, Japan (Tokyo, Tokai, and Fukushima)

[Host]

Division for Environment, Health and Safety, The University of Tokyo (UTokyo)

[Organizer]

Division for Asia and the Pacific, International Atomic Energy Agency (IAEA)

[Main Supporters]

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Japan Atomic Energy Agency (JAEA) 国立研究開発法人 日本原子力研究開発機構 Japan Atomic Energy Agency	Japan Nuclear Human Resource Development Network (JN-HRD Network) JN-HRD.NET
Scientific & Technology Information Forum (STIF) STIF	Grants-in-Aid for Scientific Research (KAKENHI) 科研費 KAKENHI

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TRAINING FOR TEACHERS 2019

Regional Training for Teachers to Introduce Nuclear Sciences in Secondary Schools through Innovative Approaches

For the IAEA Technical Cooperation Project, RAS00079
Educating Secondary School Students and Techers on Nuclear Science and Technology

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Message from Director of the Technical Cooperation Division for Asia and the Pacific, IAEA ----------

Dr Jane GERARDO-ABAYA

It is my pleasure to welcome the participants to the "Third Regional Training for Teachers to Introduce Nuclear Sciences in Secondary Schools through Innovative Approaches" under the IAEA technical cooperation four-year project RAS0079 on "Educating Secondary School Students and Science Teachers on Nuclear Science and Technology".

Allow me first to thank the University of Tokyo, and particularly Prof. Norio MATSUKI, Executive Vice President in charge of Environment, Health and Safety and Prof. Takeshi Iimoto, for all their efforts to support the organization, funding of the participants, and hosting of this course.

Nuclear technology has significantly contributed to enhancing prosperity and quality of life in many parts of the world, including in Asia and the Pacific. In order for these efforts to continue, professionals in this field in every generation are needed. It is therefore vital to reach out to young students, who can become the next generation of scientists and engineers. This is what triggered the development of this project.

Two years ago, in March 2017, the University of Tokyo, supported by JSPS Grants in Aid for Scientific Research and RADI project operated by Japan Science Foundation (JSF) hosted the "International Workshop for Preparation of Standard Education Programmes and Modules on Nuclear Energy and Radiation Applications for Secondary Schools". The workshop developed the Nuclear Science and Technology Framework which became the reference for the 7 courses planned under this regional project.

This two-week course starting at the University of Tokyo today, is the 3rd of a series of 7 spanning over 2 years. It aims to strengthen teachers' understanding of nuclear science and technology to confidently convey the subject matter to students through effective, engaging teaching and learning processes.

The first week provides participants with substantive scientific sessions, while the second week consists of the pedagogical aspect by which these scientific topics can be delivered by the teachers in an interesting and absorbing manner.

Through this approach, called the 'Cascade Effect', the trained teachers are expected to train other teachers on their return; who in turn will impart the knowledge to their students. To date we have trained over 75 teachers from 2 training courses and scientific visits.

As a participant in the course, it is expected that you too become mentors to other teachers in your home countries, and thus be a part of the critical mass trained for this purpose. Students under your tutelage have the opportunity to learn the topic, and therefore be part of the result targeted: one million students and beneficiaries by 2021.

Through the experience, lessons learned from all 7 courses, a robust IAEA training package on NS&T for secondary schools for the MS will be produced.

We have come a long way since the initial piloting of this programme in 2014, and we are grateful to Japan Team, led by Prof Iimoto-san together with several partners and countries for the staunch support for this mission to demystify nuclear science and technology to the younger generation, and in so doing, excite the interest for the topic and support for the development of the future workforce on NS&T.

As I wish everyone a successful, inspiring and interesting training, I would like to remind the need to develop the action plan to propagate the knowledge and experience at your home countries.

In my new capacity as Director of the Asia and Pacific Division-Technical Cooperation department, I reiterate support to education and training to promote NS&T among young generations, and assure you of our continuing commitment for the implementation of relevant the follow-up actions for this project.

I wish each one of you an interesting, absorbing and inspiring training course for the benefit of the young generation.

Message from Director of TTWS2019JPN ----------

Takeshi IIMOTO, The University of Tokyo

Welcome to our workshop, IAEA "TTWS 2019 JPN" hosted by The University of Tokyo (UTokyo) and organized by International Atomic Energy Agency (IAEA) led by Dr. Jane Gerardo-Abaya, the director of Department of Technical Cooperation, Asia and the Pacific Division.

First of all, as the director of the workshop, I would like to express my sincere gratitude to all lecturers including Ms. Petra Salame from IAEA, Dr Sabharwal Sunil, Mr Dimas Irawan and Ms Micah Pacheco as the international experts, and all the other members who participated in and cooperated with our workshop. In addition, a lot of Japanese organizations supported us; Japan Atomic Energy Agency, Ministry of Foreign Affairs, Ministry Education Culture, Sports, Science and Technology, Scientific and Technology Information Forum, KAKENHI, Japan Nuclear Human Resource Development Network, Japan Atomic Energy Relations Organization, Japan Science Foundation, Fuji Electric Company Limited, Chiyoda Technol Corporation, and K C Consulting company. Again, I express my deep gratitude to them.

This workshop is aimed to improve the nuclear science and technology (NST) literacy in each country of the Asia Pacific region, and to train star instructors who will be the core of school education. I believe for any country, it is important to foster fundamental science and technology literacy in order to improve the public understanding regarding maintaining environmental safety and health, and to ensure energy security. Japan experienced a large nuclear disaster in Fukushima. Therefore, I added a strong message in the curriculum to build risk literacy on NST application and social viewpoints. In addition, I would like to emphasize the fact that application of NST should not only focus on the energy production but on the wide variety of fields including medicine, industry, agriculture, etc. These backgrounds established my basic concepts to select the target facilities to be visited in the workshop. The keywords through the workshop which I determined are "two-way communication", "feedback", "STEAM", "WOW ", and "enjoy". These words will lead to the success of our mission.

I am very happy to accept all of you to Japan in the beautiful early spring when plum blossoms begin to bloom. Through our activity, I would like everyone to enjoy Japanese culture, atmosphere and meals as well as the NST trainings. Let's enjoy our workshop together with WOW factor, and please share your experiences and impression with your colleagues as much as possible. I hope this two-weeks workshop of will be meaningful not only for you but for your country, the larger region, and even the whole world.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

From 18th February to 1st March 2019, Japan hosted a two-week training course for secondary school teachers under the technical cooperation project, RAS0079, of the International Atomic Energy Agency (IAEA). This workshop is the third in a series of trainings for teachers from the Asia-Pacific region planned in the RAS0079 TCP - *"Educating Secondary Students and Science Teachers on Nuclear Science and Technology"* – which runs from 2018 to 2021. The first and second workshops, held in April and August of 2018, were in Yogyakarta, Indonesia and Illinous, United States of America (USA) respectively.

Nuclear science and technology (NST) contributes to the health and wellbeing of mankind through the peaceful application of nuclear technology in various areas including food, agriculture, health, and energy production. There are nine in 17 sustainable development goals (SDGs of United Nations) to which NST does or could potentially contribute. The sustainable application of nuclear technology requires a strategic approach for ensuring the availability of nuclear professionals across all generations. As part of achieving continuity in nuclear workforce across the world and generations, the IAEA introduced TC programs intended to motivate and inspire young people to pursue careers in NST. Recognizing the importance of the formative years of secondary level, some of these TCPs are targeted at secondary school teachers and students. For the Asia-Pacific region, this began with a pilot programme under the RAS0065 TCP (2012-2017) – *Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region*. This pilot started with the development of "A Compendium of Resources and Activities for Secondary School Teachers and Students on Nuclear Science and Technology" compiled from countries that had successfully implemented them for outreach activities. Aimed at increasing awareness and appreciation for NST among the youth so that they can ultimately choose to pursue careers in NST and emphasizing on activities with a WOW factor, this pilot was successfully carried out in Malaysia, Indonesia, Philippines and the United Arab Emirates (UAE) from 2014. By the time of conclusion, a cascade effect was observed where the original number of fifteen teachers trained subsequently trained 1,364 additional teachers in the four pilot countries and three others that joined along the way: Thailand, Sri Lanka and Jordan.

It is against this background that the RAS0079 TCP was born in order to reach out to all countries within the Asia-Pacific region with a target of one million (1, 000, 000) students by the year 2021.

The 2019 Japan workshop (TTWS2019JPN) focused on introducing the teachers to the basics of nuclear and radiation science, their peaceful applications, their associated safety and security issues, and career prospects. Consisting of lectures, experiments, site visits, and tours, the workshop was carried out in three locations of Japan: Tokyo, Ibaraki, and Fukushima.

The IAEA provided financial support for all international travel and expenses of participants, while local expenses were supported by The University of Tokyo through Professor Takeshi Iimoto. The Japan Atomic Energy Agency (JAEA) supported the workshop through local travel, accommodation, venues as well as technical visits to their facilities: a reprocessing research

center (NUCEF), a research reactor (JRR-3) and a particle accelerator (J-PARC). The Ministry of Foreign Affairs (MOFA) and Ministry Education Culture, Sports, Science and Technology (MEXT) also provided official support including logistical procedures. The organising team reflects the cooperation of players from diverse range of nuclear fields in Japan as evidenced by members' affiliations: The University of Tokyo, JAEA, Scientific and Technology Information Forum (STIF), Japan Nuclear Human Resource Development Network (JN-HRD Network), Japan Atomic Energy Relations Organization (JAERO), Japan Science Foundation (JSF), CHIYODA TECHNOL CORPORATION, Fuji Electric Company Limited, and KC Consulting company. Some of these organization also supported the workshop through stationery, experiment materials, and take-home packages that included a dosimeter and natural radioactive sources.

Handy Dose Meter (Dose-e)	Fuji Electric Company Limited
Radiation Sources of Naturally Occurring Radioactive Materials	Japan Science Foundation (JSF)
Stationaries	Fuji Electric Company Limited
Stationaries	Chiyoda Technol Co.
WS bag	Chiyoda Technol Co.

1.2 PURPOSE, SCOPE, AND OUTPUTS

The purpose of this training course was to develop the teachers' understanding of nuclear science and technology topics and equip them with creative and exciting methods, tools, and ways in which they can subsequently deliver such topics to their own students. From the training, the teachers can effectively influence human resource development in their own countries through inclusion of appropriate and well-informed NST topics in the curriculum as well as delivery of the content inside and outside classroom. The course content was delivered though lectures, technical tours of sites of nuclear interests, practical exercises, movies, and pedagogy in keeping with the methodology applied in the RAS0065 that aims at facilitating experience sharing by:

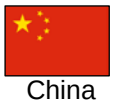
1. Introducing the participants to various learning modules and strategies for the implementation of selected activities, experimental procedures and other resources that are compatible with secondary level curriculum for nuclear sciences.
2. Conducting training activities for teachers to give them necessary insights to the learning experience and their individual plan to integrate such activities into their curriculum.
3. Enhancing the understanding of participants about applications of nuclear sciences through hands-on experiences and visits to nuclear facilities.

2 PARTICIPANTS, LECTURERS AND ORGANISERS

12 countries were represented in the workshop where the 16 participants in attendance, and listed in Table 1, consisted of 7 women and 9 men. 11 were secondary school teachers and 5 were officials from ministries of education in their respective countries with some having served as teachers as some points.

Table 1. Lists of Participants, Organizer, Lecturers and Host

Participants

Country	Name	Affiliation
 Cambodia	Dr ROS, Soveacha	Deputy Director General and Spokesperson, Ministry of Education, Youth and Sport
 China	Ms. GAO, Ying	Director, Beijing No.8 Middle School
 Israel	Ms. SHARVIT, Raymond Smadar	Science Teacher and Training Coordinator, Carasso Science Park
 Lebanon	Mr. KANBAR, Ali	Coordinator of physics department , Ministry of education and higher education DOPS
 Malaysia	Mr. KANNIAPAN, Anandan	Assistant Director, Ministry of Education, Malaysia
	Mr. MOHD KHAIRUL ANUAR BIN, Md Mustafa	Teacher, Ministry of Eduation, Malaysia
 Mongolia	Mr. TUMURCHUDUR, Dugerragchaa	Principal, Mongol Aspiration International School
 Myanmar	Ms. SHWE, Wuthmon	Lecturer, Pathein Education College
 Nepal	Mr. KHADKA, Kumbaharaj	Secondary Teacher, Shree Janapriya Secondary School, Bagadgaun Bajhang
 Oman	Ms. AL HABSI, Nabil Saif Mater	Innovation Specialist, Innovation and Scientific Olympiad Department, Ministry of Education of Oman
	Ms. BAIT SALEEM, Nada Said Mabrook	Trainer at Innovation and Robotic Center, Directorate of Education Ministry of Education of Oman

Country	Name	Affiliation
 Philippines	Ms. DINGLASAN, Luzviminda Abastillas	Science Master Teacher I, Department of Education-Dona Teodora Alonzo High School
	Mr. GALLAMASO, Edman	CID Chief /SST-IV, Philippine Science High School - SOCCSKSARGEN Region Campus (PSHS-SRC)
 Sri Lanka	Ms. ADHIKARI PATHIRANA, Chathurika Sanjeewanee	Science Teacher, WP/GM Siyane National School, Palugama, Dompe, Sri Lanka
 Thailand	Mr. LIMPAJEERAWONG, Thanapong	Physics Teacher, Princess Chulabhorn Science High School Phetchaburi
	Ms. SUWAN, Yuwadee	Physics Teacher, Princess Chulabhorn Science High School Phetchaburi

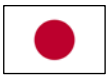
International Atomic Energy Agency (IAEA)

Country	Name	Affiliation
 Lebanon / France	Ms. SALAME, Petra	Program Management Officer, IAEA

IAEA International Experts

Country	Name	Affiliation
 India	Dr. SABHARWAL, Sunil	Radiation Processing Specialist, Former IAEA
 Indonesia	Mr. IRAWAN Dimas	Dissemination Manager, National Nuclear Energy Agency of Indonesia (BATAN)
 Philippines	Ms. PACHECO, Micha G.	Education Program Supervisor (Science), Department of Education – National Capital Region

Supporting Lecturers

Country	Name	Affiliation
 Philippines	Dr. RODRIGUEZ, Perpetua	Invited Researcher, JAEA
 Japan	Prof. FUJII, Hirofumi	Chief of Division of Functional Imaging, National Cancer Centre
	Prof. WAKABAYASHI, Genichiro	Assistant Professor, Kindai University
	Prof. TAKASHIMA, Ryuta	Assistant Professor, Tokyo University of Science
	MAEDA, Toshikakatsu	Leader of Waste Safety Research Group, JAEA
	Prof. OKAMOTO, Koji	Professor, The University of Tokyo
	Prof. UESAKA, Mitsuru	Professor, The University of Tokyo
	Ms. MAKABE, Kayo	Manager, Japan Atomic Energy Relation Organization
	Prof. YAMAGUCHI, Katsuhiko	Professor, Fukushima University
	Mr. TODA, Takehiro	Developer of cloud chamber, RADO Co. Ltd.
	Mr. KAKEFU, Tomohisa	Manager, Japan Science Foundation
	Mr. KATO, Taichi	Lecturer, Japan Science Foundation

Host Team of the Workshop

Country	Name	Affiliation
 Japan	Prof. IIMOTO, Takeshi	Professor / Director of TTWS2019JPN, The University of Tokyo
	Ms. TAKAKI, Rieko	Secretariat of TTWS2019JPN, Science & Technology Information Forum
	Mr. IGARASHI, Yu	Doctor Course Student, The University of Tokyo
 Malawi	Ms. KATENGEZA, Estiner Walusungu	Visiting Researcher, The University of Tokyo
 Sri Lanka	Mr. RANASINGHE, Nirodha	Visiting Researcher, The University of Tokyo Scientific Officer, Sri Lanka Atomic Energy Board
 Bangladesh	Mr. MD MAHAMUDUL, Hasan	Master Course Student, The University of Tokyo

3 COURSE DESCRIPTION

The training course spanned over two weeks with most technical materials and their associated experiments and tours covered in the first week. The second week concluded the technical tours and focused more on knowledge sharing through pedagogy sessions. The workshop content is summarised in Table 2:

Table 2: Content of the TTWS 2019 Japan workshop

		CONTENT	LECTURER
WEEK ONE	L1	Overview of Nuclear Applications	Dr. Subharwal
	L2	Basics of Nuclear Physics	Ms. Katengeza
	L3	Radiation Biology	MD, Dr. Fujii
	L4	Radiation Measurement and Dosimetry	A-Prof. Wakabayashi
	L5	Social Viewpoint on Nuclear Application	A-Prof. Takashima
	L6	Over all Review of Radiation Basics	Movie
	L7	Radiation Protection Concept	Prof. Iimoto
	L8	Radioactive Waste Management	Dr. Maeda
	L9	Nuclear Non-Proliferation and Nuclear Safeguards	Dr. Rodriguez
	L10	Types of Nuclear Reactors and Their Safety & Security	Prof. Okamoto
	L11	Types of Accelerators and Its Application	Prof. Uesaka
	L12	Extracurricular Activities of Nuclear S&T	Ms. Makabe
	L13	Fukushima Daiichi NPP Accident and Way to Recovery	Movie
	L14	Radiation Education in Various Subject Classes	Prof. Yamaguchi
	S1	Sustainability of HRD on Nuclear S&T and Its Motivation	Dr. Subharwal
	S2	Main Points and Future Scope on NS&T Secondary Education	Prof. Iimoto
	E1a	Cloud Chamber Observation	Mr. Toda Ms. Takaki
	E1b	Illustrating radiation concepts with Hand-made Air GM Tube	Team UTokyo
	E2	Natural Radiation Survey with KIND	Mr. Kakefu Mr. Kato
WEEK TWO	L15	Recent status of Fukushima Daiichi NPP and Future Scope	TEPCO Interpuriter: Mr. Igarashi
	S3	Careers and Opportunities in Nuclear Science and Technology	Dr. Salame
	S4	Expected National Implementation Strategy for the Envisaged	Dr. Salame
		Pedagogy 1-6	Mr. Irawan Ms. Pacheco
Legend: L = Lecture, E = Experiment, S = Special lecture			

The organization and delivery of the content was such that it provided the participants with diverse options for content delivery so that they can customise their subsequent actions to their specific environment.
The content also targeted to deepen the understanding of real-life peaceful applications of nuclear technology and appreciation of the pertinent safety and security issues through the technical tours of nuclear and radiation facilities. Finally, it provided inspiration and motivation for creativity, innovation, and propagation of training contents through testimonies of success stories of the RAS0079 alumni and experiential use of materials custom-developed for radiation education in Japan during some practical exercises.
Lecturers came from academia, industry, and other institutions.

3.1 WEEK ONE

The workshop kicked off at The University of Tokyo where it was officially opened by Mr Syoichi Matsui, the Deputy Director General of the University's Division for Environment, Health and Safety. This was followed by welcome addresses by Professor Norio Matsuki (UTokyo) and, via video message, Dr Jane G-Abaya, Director of Technical Cooperation division for Asia and the Pacific at the IAEA. Guest speeches were also made by representatives from two Japanese government ministries: Foreign affairs (MOFA) and Education, Culture, Sports, Science, and Technology (MEXT). Respectively, these are Mr Koichiro Matsumoto and Dr Taro Ide. Dr Sunil Sabharwal, an IAEA expert from India, introduced the IAEA RAS0079 TCP to bring the workshop into context. Professor Takeshi Iimoto winded up the opening ceremony by a presentation on workshop's training objectives and schedule.
The first week content started with basic nuclear science topics building up into application, safety and security topics as well as the corresponding social aspects. This approach aimed at ensuring that a proper foundation was set for understanding the more advanced topics, the experiments, and the technical tours. The participants also appreciated radiation detection and measurement concepts as well as means of illustrating radiation properties by conducting experiments using hand-made air GM counters, cloud chambers and radiation survey meters developed in Japan.

Table 3: Overview of week one of the Workshop

Time	Sunday 17 Feb	Monday 18 Feb [1]	Tuesday 19 Feb [2]	Wednesday 20 Feb [3]	Thursday 21 Feb [4]	Friday 22 Feb [5]	Saturday 23 Feb [6]
AM	Arrival at Tokyo	-Opening(1,2) -Lecture(1) UTokyo	-Lecture(5,6) -Reporting UTokyo	-Greetings -Lecture (7,8,9) JAEA	-Visit (JAEA) JAEA	- Iimoto Lab Seminer* - Sunil's Seminar** JAEA	-Lecture (12,13, S4) Utokyo
Lunch		UTokyo restaurant	Free	Bento	Bento	Bento	Bento
PM		-Visit (UTokyo) -Lecture (2,3,4) UTokyo		-Experiment (1a, 1b) JAEA	-Visit (JAEA) JAEA	-Lecture (10,11,S3) JAEA	-Experiment(2) -Lecture(14) -Reporting UTokyo
Night		Welcome Party	7pm, UTokyo to Tokai by bus	-Shopping to Mall by bus		Card-Game Competition (Applicants)	
Stay	(A) Hotel Forest Hongo	(A)	(B) JAEA or UTokyo Dormitory	(B)	(B)	(B)	(B)

*International Safety Framework of Radioactive Waste Management : Nirodha RANASINGE, Mr (UTokyo, Sri Lanka)

**Overview of NST

Three facilities of the JAEA constituted the first week's technical tours which, in order of appearance, are:

a. Nuclear Fuel Cycle Safety Engineering Research Facility (NUCEF) where participants learnt and saw various equipment related to fuel reprocessing, criticality safety for the fuel that is reprocessed, and simulation of criticality accident.
b. Japan Research Reactor-3 (JRR-3), a 20 MW facility where various experiments are conducted using neutrons produced therein and taken out at various ports around the numerous beam lines. This brought context to the topic covered during the workshop.
c. Japan Proton Accelerator Research Complex (J-PARC) which has three accelerators namely a 400 MeV Linear Accelerator (LINAC), a 3 GeV rapid cycling synchrotron, and a 50 GeV main ring. This provided an opportunity for participants to appreciate the application in material science, fundamental research, and so much more.

3.2 WEEK TWO

This week concluded the technical tours by visiting TEPCO Museum of Decommission of the Nuclear Reactor in Fukushima as well as the Fukushima Daichi Nuclear Power Station site. The TEPCO tour of the NPS included explanations of the events that happened, the damage that ensued, the progress and status of the work and efforts towards its decommissioning, waste management, and the social responsibility and actions toward recovery and revitalization of the

affected areas in Fukushima. These points are also illustrated in the museum though simulations, videos, and other displays.

Table 4: Overview of week two of the Workshop

Time	Sunday 24 Feb	Monday 25 Feb [7]	Tuesday 26 Feb [8]	Wednesday 27 Feb [9]	Thursday 28 Feb [10]	Friday 1 Mar [11]	Saturday 2 Mar
AM	Free	7am, Tokai to Fukushima#1 NPP by bus	-Reporting -Making each education plan (Self-activity)	-Lecture (S1, S2) -Pedagogy 1 JAEA	-Pedagogy 3 JAEA	-Pedagogy 5 JAEA	Leaving Tokyo
		-Visit (Fukushima#1 NPP) -Lecture(15) TEPCO					
Lunch		Bento		Bento	Bento	Bento	
PM				-Pedagogy 2 JAEA	-Pedagogy 4 JAEA	-Pedagogy 6 -Conclusion JAEA	
		4pm, JAEA to Iwaki by bus	3pm, Iwaki to Tokai by bus			4pm, Tokai to Hongo by bus	
Night		Hotel Buffet			FarewellParty	Free	
Stay	(B)	(C) Spa Resort Hawaiians	(B) JAEA or UTokyo Dormitory	(B)	(B)	(A) Hotel Forest Hongo	

The special lecture from Dr Petra Salame, the Programme Management Officer of IAEA, addressed one key question that stood out from the participants: “what kind of career paths or prospects in NST can we communicate to students?” After this lecture, Dr Salame covered the envisaged and expected National Implementation strategy pertaining to NST education for secondary schools. From a historical perspective for nuclear education that motivated and culminated into the RAS0079, to the goals of the RAS0079 and the strategy and approach for achieving these goals.

The rest of the week involved knowledge sharing through the three-day pedagogy sessions with a focus on topics relating to curriculum development, supporting resources, and testimonials as listed below:

Table 5: Content of the Pedagogy in TTWS 2019 Japan workshop

		CONTENT	LECTURER
PEDAGOGY	P1	Developing Soft Skills	M. Pacheco
	P3	Pedagogies in Teaching NST 1, 2	M. Pacheco D. Irawan,
	P5	Introduction to Digital Resources for NST Teaching 1, 2	D. Irawan
	P7	Application of Digital Resources & Multimedia	D. Irawan
	P8	Best Practices of Academic Activities for NST Learning in Pilot Countries	D. Irawan
	P9	Best Practices of Extra Curricular Activities for NST Learning in Pilot Countries	M. Pacheco
	P10	Lessons Plan Development 1, 2 ,3, 4	M. Pacheco D. Irawan
	P12	Group Simulation & Presentations	ALL PARTICIPANTS
P = pedagogy			

The presenters and leaders of the pedagogy section are alumni of the pilot project for the Asia-Pacific region, RAS0065 and represent success stories of the initiative. Ms Micah Pacheco, a former teacher, currently works as the Education Programme Supervisor responsible for Science in the Department of Education of the Philippines and Mr Dimas Irawan works for the Indonesian National Nuclear Energy Agency. These alumni were also engaged for similar presentations at the workshop that took place in Argonne, USA in 2018. They presented some of the NST education activities that are being implemented in their countries, how they are doing it, and some free-access IT applications and websites that can be used to support NST education initiatives. These sessions were very interactive involving practical exercises for teams and individuals. It concluded with participants simulating a lesson based on the tools, methods, and techniques learned during the pedagogy as well as other tools that the respective group members use in their own settings. Various IT tools were also brought to light from these group exercises thus increasing each participant's pool of supporting resources.

4 RETURN ON IMVESTMENT

The last section of the pedagogy was the presentation of each represented country's action plan as envisioned by attendee(s) based on their sphere and level of influence. This provided an overview of the projected impact of the workshop and its contribution to the RAS0079 target of reaching one million (1,000,000) students by the year 2021.

COUNTRY	PLATFORM	PROJECTED REACH (ANNUAL)	
		TEACHERS	STUDENTS
Cambodia	• Ministry • Start with workshop for new generation (pilot) school • Policy dialogue	20	100
China	• NST already in curriculum • Site visits, science camps & fares • Research clubs	300	6,000
Israel	• Science park: students, teachers & community outreach • School(s)	40	1,200
Lebanon	• Existing national science competitions, science fares, • Advocate for inclusion of NST option in national examination.	175	2,625
Malaysia	• Ministry of Education wants to integrate with Malaysia STEAM* movement. Upcoming meeting will gather 16 departments of MoE.		10,640
Mongolia	• Robotics competitions already in place (encourage NST theme). • Video blogging already in place • Existing science clubs in schools: encourage NST theme.		200
Myanmar	• Ministry of education	50	2,000
Nepal	• Introduce NST to teachers	20	800
Oman	• Regular national workshops for teachers already in place: hosts 24 teachers at a time. Start here. • Some 9 teachers have already started own regional workshops • National science fares	24	2,520
Philippines	• Existing national NST workshops for teachers • Youth summits, NST clubs, POWERSET initiatives, Science fares, competitions, • special elite schools focusing on STEAM with NST as alternative stream • Research advisor mentor program	32	6,768
Sri Lanka	• Existing national programmes with NST Modules		
Thailand	• Science fares & peer teachers	20	1,728
	TOTAL ANNUAL PROJECTION	**411**	**34,581**

*STEAM: Science Technology Engineering Art and Mathematics

5 EVALUATION

Two-way evaluation was conducted during the workshop: lecturers testing the participants grasp of the contents and the participants evaluating the presentations. For the former, the participants were quizzed with five multiple choice questions derived from each lecture's contents while the latter involved several questionnaires with both multiple choice and free responses (Questionnaires (1)-(3)). The evaluations were designed not only to gauge the participants' understanding and opinion of the lectures but also their self-assessment of level of prior knowledge of the content and the impact of the lectures.

The participants were quizzed immediately after each lecture and had the same questions in hard copy for response during self-study session. Twelve (12) lectures and three (3) experimental exercises were examined with five multiple choice questions per set, making a total of 75 questions. Questions of Plickers are shown in Appendix C-1. These same questions were provided to the participants in hardcopy for use during their self-study sessions and were included, with answers, in their take-home packages. Further, the participants were provided with questionnaires in which they could assess their own level of knowledge of the lecture content prior to the lecture and whether, after the lectures, they felt that they would need further explanations (Questionnaires (1)-(3)). These are shown in the Appendix C 2-4

Generally, the current crop of participants showed some significant knowledge (> 50%) of the basics of nuclear physics and radiation, types of reactors, and some nuclear applications. It can be clearly seen that the workshop had a positive impact by the overage of the marks obtained vis-à-vis the prior knowledge. Also supporting this view was that there is very low need for further explanation except for social viewpoints of nuclear applications and radioactive waste management. A further notable improvement is seen with the self-study session suggesting that these sessions and intermediate discussions may have higher effect on knowledge absorption. These results also highlight and emphasize the importance of the selected NST topics. More detailed analysis on these questionnaires will be officially opened in near future.

6 CONCLUSIONS

One of the participants wrote his opinion as "This program changed my perception about nuclear. I am more positive about nuclear and ready to transform my teachers mind set back home in my country. I am more confident now for a positive transformation." Another participant mentioned "This workshop enhanced my competence in nuclear science as well as made the principles and concepts more concrete and realistic. The facility visits greatly increased my knowledge in nuclear science w/c is usually read and scanned in the textbook or multimedia."

These two messages are representative of the expected reactions and match the hopes of the host. We believe the continuous motivation of participants to our workshop could lead to a success for the strong movement to establish, improve and maintain the stable literacy of nuclear science and technology in the region. We look forward to receiving the feedbacks from the participant countries based on the activity in our workshop.

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EDITOR'S NOTE ----------

Estiner KATENGEZA, The University of Tokyo

What an absolutely incredible opportunity it was to be a part of such a great workshop that brought brilliant people from diverse cultural and academic backgrounds! It was profoundly humbling to be a one of the members of the host team UTokyo under the leadership of Professor Iimoto, to learn from so many brilliant lecturers and experts in their field, to appreciate nuclear applications through the technical tours, and to be entrusted with editing the final report.

I have learnt so much, not only from the workshop contents but also from the interactions with all the members at various levels: organisation, time management, Japanese culture, networking, inter-personal skills, just to mention a few. I trust that all the participants will yield positive results in their respective countries and help surpass the RAS0079 target of reaching 1 million teachers and students by 2021. It is my hope that the contents of this report are clear, coherent, truly reflective of the workshop, and that it will be helpful to the readers. I am truly grateful and believe that my life will never be the same.

APPENDIX

A. Opening statements
   A-1 Opening Address (Mr Shoichi MATSUI, General Manager, Environment, Health and Safety, UTokyo)
   A-2 Welcome Address (Prof. Norio MATSUKI, Executive Vice President in charge of Environment, Health and Safety, UTokyo)
   A-3 Guest Speech (Mr Koichiro MATSUMOTO, Director, International Nuclear Energy Cooperation Division, Disarmament, Non-Prolliferaion and Science Department, MOFA)
   A-4 Guest Speech (Dr Taro IDE, Director for Decommissioning Technology Development, Research and Development Bureau, MEXT)
   A-5 Closing Address (Prof. Takayuki TERAI, Director of Radiation Control Department, UTokyo School of Engineering, UTokyo)

B. Closing statement
   B-1 Greetings for Closing TTWS 2019 JPN (Prof. Takeshi IIMOTO, Director of TTWS2019JPN, Division for Environment, Health and Safety, UTokyo)

C. Questionnaires
   C-1 Questions for Plickers in each lecture
      : Plickers application was used for this exercise. Questions were projected, one at a time, and the unique QR code assigned to each participant was scanned using the Plickers applications' QR code reader that had been preinstalled on a mobile phone. Each of the four sides of the QR code represents an option, distinguished as a sub-QR code, for the answer. Thus, depending on the orientation selected, the participant gave the chosen option. The correct answer was displayed before proceeding to the next question.
   C-2 Questionnaire(1)
   C-3 Questionnaire(2): Additional Questionnaire
   C-4 Questionnaire(3): Final Questionnaire

Opening Address

Mr Shoichi MATSUI
General Manager, Environment, Health and Safety, UTokyo

Good morning, everyone. Welcome to Japan.
I am Matsui, the Deputy Director of Division for Environment, Health and Safety, here at The University of Tokyo.

This meeting, held at The University of Tokyo, is attended by 16 participants from 12 countries in the Asia-Pacific region and Dr. Subharwal as an international expert from India. In addition, next week, two special instructors will join us coming from Indonesia and the Philippines. They experienced outstanding results in pilot stage activities from 2012 to 2017.

I am very happy to invite all of you to The University of Tokyo.I hope these two weeks from today will be a fulfilling period for everyone. Now, I declare the official opening of "IAEA Train Trainers Work Shop 2019 Japan". Thank you very much.

Welcome Address

Prof. Norio MATSUKI
Executive Vice President in charge of Environment, Health and Safety, UTokyo

Ladies and gentlemen. Welcome to Japan, to Tokyo, and to The University of Tokyo.
I am MATSUKI, Executive Vice President in charge of Environment, Health and Safety, of The University of Tokyo.
Right now, it is the time to go from winter season to spring in Japan. I am very pleased that we could accept you to our university in the early spring, when the air is really clear, and beautiful flowers such as Japanese plums begin to bloom gradually.

Two weeks from today to next Friday, "IAEA Train Trainers Workshop 2019 Japan" will be held here and in Tokai village located about 100 kilo-meters north from Tokyo. This workshop is officially one of the activities of IAEA RAS0079-Technnical Cooperation Programme, which is named as the Regional Training Course for Teachers to Introduce Nuclear Science in Secondary through Innovative Approaches. This workshop is aimed to improve the nuclear science and technology literacy in each country of the Asia Pacific region, and to train star instructors or teachers who will be the core of school education. Based on our experiences of Japan concerning the high-levelled nuclear science and technology, Professor IIMOTO of our university hosts this regional workshop. For the technical cooperation program of IAEA from 2012, Professor IIMOTO organized Team JAPAN. Actually, he is taking leadership in these related activities. The activity of Team JAPAN has received extremely high evaluation not only from IAEA but also from related ministries and agencies of Japan such as the Ministry of Foreign Affairs and the Ministry of Education, Culture, Sports, Science and Technology. We are really proud of it.

In any country, it is important for the government to foster fundamental science and technology literacy with responsibility in order to improve the public understanding regarding maintaining environmental safety and health, and also ensuring energy security. I highly appreciate the involvement of stakeholders recommended by the Asia-Pacific education ministries in the IAEA technical cooperation program. Education based on the STEAM, Science and Technology, Engineering, Art, and Math, for secondary school students before the entrance to university will be a powerful key for fostering science and technology literacy. I am an expert in pharmacy. Even in my field of specialization, from the viewpoint of human resource development, STEAM approach using WOW factor is considered as important. In Japan, experienced the large nuclear disaster in Fukushima, risk literacy of nuclear energy and radiation is also an important theme. I hope that all participants share experiences on risk education in Japan at this workshop, and that a lot of talented instructors with balanced sense will develop in the Asia-Pacific region. I hope the success of this workshop and great achievements.

Finally, using this opportunity, I would like everyone to enjoy Japanese culture, atmosphere and meals. There are many historical sites and sightseeing spots around The University of Tokyo. I hope you will enjoy and feel Japan. Thank you for your attention.

Guest Speech

Mr Koichiro MATSUMOTO
Director, International Nuclear Energy Cooperation Division,
Disarmament, Non-Prolliferaion and Science Department, MOFA

It is my great honour to be here and welcome you today, at the opening session of this International Workshop co-organized by the IAEA and the University of Tokyo.

Nuclear science and technology are not only for power generation. Its peaceful applications are also related closely to the improvement of Quality of Life. Medical care, water resource management, radiation breeding, and industrial applications are some of the examples.

The Government of Japan has been committed to promoting the peaceful uses of nuclear technology, and strongly supports the efforts of the IAEA to achieve the United Nations Sustainable Development Goals, under its mandate "Atoms for Peace and Development".

Especially, we attach great importance to its Technical Cooperation Programs as one of the major vehicles to accelerate and enlarge the contribution of nuclear science and technology for peace, health and prosperity throughout the world, and have been providing assistance to its activities through the contribution to the Technical Cooperation Fund since 1959.

For further and safe application of the nuclear science and technology, the sufficient understanding of the technology is necessary. For that purpose, education and human resource development in the field is indispensable. We highly appreciate the initiatives taken by Prof. Iimoto and his team to develop handy equipment and educational programs for easier access to the education of the field, as well as the human resource development of the qualified teachers.

Since its foundation, The University of Tokyo has been fostering qualified leaders in various fields as the top educational institution in Japan. In my view, it is the most suitable organization to host this Workshop.

Teachers in secondary schools are the key to dissemination of basic knowledge and future scientific development. I hope that this Workshop will help enable the wider range of people in each country to have better access to the benefit of nuclear technology for their Quality of Life in the future. I also hope that this Workshop will strengthen the ties among participants.

Finally, I would like to express my sincere gratitude to The University of Tokyo and its team members, as well as the IAEA secretariat for organizing this Workshop.
Thank you.

Guest Speech

Dr Taro IDE
Director for Decommissioning Technology Development,
Research and Development Bureau, MEXT

It is my great honor to have an opportunity to deliver an opening remark in this IAEA International Workshop of regional training course for teachers.

First of all, I would like to express my hearty welcome to all participants from the Asia-Pacific region. I would like to express my deep gratitude to The University of Tokyo and the Japan Atomic Energy Agency for their hospitality to host this workshop. I also would like to express our gratitude to all relevant ministries, institutes, countries, and IAEA for great cooperation

Our Ministry, MEXT has promoted three sustainable international programs for effective cooperation for peaceful use of nuclear technology in Asian countries.

Firstly, FNCA, Forum for Nuclear Cooperation in Asia is an international cooperation framework for peaceful use of atomic energy in Asian countries led by the Cabinet Office and the MEXT.

The FNCA member countries promote cooperative activities focusing on joint research and information exchange in the fields of nuclear energy, based on equal partnership.

MEXT has promoted other two programs, Nuclear Researchers Exchange Program (NREP) and Nuclear Instructor Training Program (ITP) for supporting to develop nuclear human resources in Asian countries.

NREP provides nuclear researchers from Asian countries with an opportunity to experience study and work at Japanese research laboratories.

ITP invites nuclear instructors from Asian countries to training courses for building capacity of their skills in Japan, then provides follow-up training courses in their countries.

I heard that Japan’s team led by Professor Takeshi Iimoto has contributed to improvement of radiation education in Asia-Pacific region by providing Japanese knowledge, technologies and tools through the IAEA Technical Cooperation Programme.

In Addition, Japan and other leading countries in nuclear field will learn many things while tackling new research and development based on the feedback from Asian countries.

I understand that this case is one of the meaningful activities for the development of Asian countries in the framework of international cooperation.

I believe this workshop will provide a great opportunity for participants to discuss about the cases of international cooperation on radiation education activities in international institutions and leading countries, and the current status and establishment of a sustainable framework of radiation education at junior and senior high schools in Asian countries.

MEXT highly evaluates and supports these international collaborative activities related to such nuclear science and technology education.

MEXT continues to actively support development of nuclear human resources by strengthening cooperation between MEXT programs to develop nuclear human resources and various domestic and overseas activities such as this workshop.

I hope that this workshop will be meaningful for all participants.

Finally, I wish all participants continued success and prosperity in the future.

Thank you for your kind attention.

Closing Address

Prof. Takayuki TERAI
Director of Radiation Control Department, UTokyo School of Engineering, UTokyo

I am Terai, the Director of Radiation Management at The University of Tokyo, with the responsibility to formulate radiation safety strategy.

As one of the members of The University of Tokyo, I am glad to have an opportunity for a lot of participants to attend this workshop from many countries. My specialty is nuclear fusion reactor engineering from a viewpoint of the material science. Energy and environmental problems are in the scope of my field of expertise. The role of everyone here, being the key persons to educate next generation members, is quite large. I hope this workshop of two weeks will be meaningful not only for you but for your country, larger region, and even the whole world.

Now I declare the closing of this opening ceremony.

Greetings for Closing TTWS 2019 JPN

Prof. Takeshi IIMOTO
Director of TTWS2019JPN,
Division for Environment, Health and Safety, UTokyo)

Now is the time for two special presents from Team JAPAN to each participant.
One is the additional special certificate from the host, and the other is a radiation detector developed by Fuji-Electronics Ltd. This is a handy dose-meter with a semiconductor detector for gamma dose measurement.

First of all, as the host, I would like to express my sincere gratitude to all lecturers, Sunil, Dimas and Micah, and all the members who participated in and cooperated to this workshop. Especially, without a strong support of JAEA, Ikuta-san and Kono-san, we would not have realized the workshop and would not have succeeded. Again, thank you very much for JAEA team.
Actually, it took more than one year for us to prepare this workshop when I decided to accept the IAEA request in the Philippines in February of 2018. Takaki-san and our laboratory members, you are really the best partners and supporters of me for this mission. From bottom of my heart, thank you very much for the strong supports.

I believe all of us here learned and experienced a lot through this workshop.
Not only these knowledge and experiences, but we have established excellent personal connections. This is our best treasure and valuable things.

Let's keep in touch together and share our experiences continuously.
As I said in my lecture, the keywords for us are "two-way communication", "feedback", "STEAM", "WOW ", and "enjoy". Please remember them, and do not forget these words and continue your activity. We Team Japan is looking forward to receiving the story of your development.

Now I declare the closing of our workshop IAEA TTWS 2019 JPN. Thank you, everyone.

Lecture 01: Overview of Nuclear Applications

1. What is not a medical application of radiation?
    a) Sterilization
    b) Radiotherapy
    c) Hydrogel wound dressings
    d) SIT

2. Radiation techniques are used in,
    a) Medicine
    b) Industry
    c) Research
    d) All of above

3. SIT stands for,
    a) Sterile Insect Technique
    b) Strong Insect Technique
    c) Sterile Identification Technology
    d) Saving Insect Treatment

4. Non-destructive tests are mostly used in,
    a) Agriculture
    b) Medicine
    c) Industry
    d) Education

5. Radiotherapy is an effective treatment for,
    a) Asthma
    b) Cancers
    c) Diabetics
    d) Burn wounds

Lecture 02: Basics of Nuclear Physics

1. ɣ-ray are produced by,
   a) Bremsstrahlung
   b) Radioactive atoms
   c) Television sets
   d) Electron transitions

2. Which one has the highest ionization power?
   a) ɣ-ray
   b) X-ray
   c) Beta particle
   d) Alpha particle

3. “Bq” is a unit for,
   a) Radiation count rate
   b) Radiation energy
   c) Strength of radioactivity
   d) Absorbed dose

4. Removing one or more electrons from an atom is called,
   a) Radiation
   b) Ionization
   c) Radioactivity
   d) Isotope

5. A 120 Bq radioactive source has a half-life of 6 years. In 18 years, the source will be ____ Bq.
   a) 60
   b) 30
   c) 15
   d) 7.5

Lecture 03: Radiation Biology

1. What is the damage of the most influential DNA?
   a) Base damage
   b) Crosslink
   c) Single strand break
   d) Double strand break

2. What is the deterministic effect of radiation?
   a) Hair loss
   b) cancer
   c) Genetic Effects
   d) Leukaemia

3. What is the stochastic effect of radiation?
   a) Hair loss
   b) Genetic Effects
   c) Permanent infertility
   d) Acute ulcer

4. What is the cancer mortality rate at 100 mSv by radiation?
   a) 0.05%
   b) 0.5%
   c) 5%
   d) 50%

5. Information on the exposure of radiation to be affected by the remotely?
   a) Radical
   b) H2O
   c) Bystander
   d) Active oxygen

Lecture 04: Radiation Measurement and Dosimetry

1. Which radiation detector measures light (photons) to detect radiations?
   a) scintillation detector
   b) ionization chamber
   c) semiconductor detector
   d) Geiger-Mueller tube

2. Which radiation detector is good to identify radioactive materials contained in a sample and measure the radioactivity? (hint: both the number and energy of radiations should be measured.)
   a) Geiger Mueller tube
   b) High purity Germanium detector
   c) Ionization Chamber
   d) Thermoluminescent Dosimeter (TLD)

3. Which radiation detector can NOT measure the energy of radiations?
   a) ionization chamber
   b) Geiger-Mueller tube
   c) scintillation detector
   d) semiconductor detector

4. A radioactive source is counted for 10 min and gives 2000 counts. The source is removed and background measurement for 20 min gives 400 counts. What is the net count rate?
   a) 1600 cpm
   b) 160 cpm
   c) 12000 cpm
   d) 180 cpm

5. A radioactive source emits 2000 radiations per second. Your detector measures a net count rate of 100 cps. What is the counting efficiency of the measurement?
   a) 20%
   b) 10%
   c) 5%
   d) 1%

Lecture 05: Social Viewpoint on Nuclear Application

1. When the cost of the policy is $100 million, which policy should you implement?
   a) The benefit of $10 million
   b) The benefit of $110 million
   c) The benefit of 0
   d) The benefit of $90 million

2. VSL when WTP for reducing mortality risk by 1/10,000 is $100?
   a) $1,000,000
   b) $100,000
   c) $10,000
   d) $1,000

3. What is the model of ICRP for ERR?
   a) Supra-Linear Model
   b) Supra-Non-Linear Model
   c) Linear Non-Threshold Model
   d) Non-Linear Threshold Model

4. When ERR is converted into WTP, what values should you use?
   a) Loss of life expectancy
   b) Risk reduction
   c) Net benefit
   d) VSL

5. Which factor does NOT affect the social acceptability of nuclear energy?
   a) Risk recognition
   b) Risk reduction
   c) Cost
   d) Trust

Lecture 06: Overall Review of Radiation Basics

1. β-ray is a(n) [ ].
   a) nuclei of Helium
   b) electron
   c) proton
   d) photon

2. The unit of Bq shows a(n)[ ].
   a) level of radioactivity
   b) indicator of exposure on human effect
   c) radiation count rate
   d) radiation weighting factor

3. The unit of Sv shows a(n) [ ].
   a) level of radioactivity
   b) indicator of exposure on human effect
   c) radiation count rate
   d) tissue weighting factor

4. A radioactive material of 100 Bq with the physical half-life of 5 years will be [ ] Bq after 15 years.
   a) 200
   b) 50
   c) 25
   d) 12.5

5. The natural annual dose of the world average is [ ] mSv according to the UNSCEAR report.
   a) 4.8
   b) 2.4
   c) 1.2
   d) 0.6

Lecture 07: Radiation Protection Concept

1. “Everyday situations involving the planned operation of sources including decommissioning, disposal of radioactive waste and rehabilitation of the previously occupied land.” What is the exposure situation of this?
   a) Planned exposure situations
   b) Emergency exposure situations
   c) Existing exposure situations
   d) Usual exposure situations

2. “A situation that already exists when a decision on control has to be taken, including natural background radiation and residues from past practices that were operated outside the ICRP's recommendations.” What is the exposure situation of this?
   a) Planned exposure situations
   b) Emergency exposure situations
   c) Existing exposure situations
   d) Usual exposure situations

3. The Principle of is [ ] that the likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable (ALARA), taking into account economic and societal factors.
   a) Justification
   b) Optimization of Protection
   c) Dose limit
   d) Dose constraint

4. Under a planned exposure situation, as additional “dose limits,” [ ] mSv per year is applied to the public exposure.
   a) 0.3
   b) 1
   c) 20
   d) 100

5. Under a planned exposure situation, as additional “dose limits”, the annual average of [ ] mSv for five years is applied to the occupational exposure.
   a) 0.3
   b) 1
   c) 20
   d) 100

Lecture 08: Radioactive Waste Management in Japan

1. Fundamental measures for long-term safety to manage radioactive waste whose hazard is sustained over a long period of more than tens of thousands of years (long-lived waste) are [ ].
   a) containment and institutional control
   b) isolation and containment
   c) dilution and dispersion
   d) institutional control and discharge

2. For long-lived radioactive waste, containment of by engineered barriers is required for [ ].
   a) 300-400 years
   b) 1,000 years
   c) 100,000 years
   d) as long as reasonably achievable

3. The exposure dose by natural process for public will be decreased by [ ] in waste disposal system.
   a) containment by engineered barrier, retardation of nuclide migration by natural barrier and institutional control
   b) containment by engineered barrier, retardation of nuclide migration by natural barrier and dilution in biosphere
   c) containment by engineered barrier, monitoring and institutional control
   d) institutional control, retardation of nuclide migration by natural barrier and dilution in biosphere

4. Fundamental measure to prevent human intrusion over a long period of more than 300 years is [ ].
   a) institutional control
   b) containment by engineered barrier
   c) isolation by depth
   d) periodic safety review

5. Passive institutional controls to prevent advertent human intrusion are [ ].
   a) limitation of certain human activities, monitoring and oversight
   b) limitation of certain human activities, installation of marker and keeping records
   c) monitoring, oversight and keeping records
   d) oversight, installation of marker and keeping records

Lecture 09: Nuclear Non-proliferation and Nuclear Safeguards

1. The three pillars of the Nuclear Non-Proliferation Treaty (NPT) are [ ].
   a) Nuclear Non-proliferation, Sharing Nuclear Technology, Nuclear Disarmament
   b) Physical Protection, Export Control, Nuclear Disarmament
   c) Nuclear Disarmament, Bilateral Agreements, Physical Protection
   d) IAEA Safeguards, Physical Protection, Export Control

2. The types of IAEA safeguards are [ ]
   a) Item-Specific, Voluntary Offer, Comprehensive Safeguards
   b) Voluntary Offer, Small Quantities Protocol, Additional Protocol
   c) Item Specific, Comprehensive Safeguards, Additional Protocol
   d) Comprehensive Safeguards, Small Quantities Protocol, Additional Protocol

3. Source Material includes [ ]
   a) Depleted Uranium
   b) Natural Uranium
   c) Thorium
   d) All of the above

4. Nuclear material verification includes [ ]
   a) Non-destructive assay and Destructive assay techniques
   b) Non-destructive and Destructive Assays, Containment and Surveillance
   c) Containment and Surveillance measures
   d) Visual observation and inspection

5. Which statement (s) are true [ ]
   a) Design Information Verification is performed throughout the lifecycle of the facility
   b) Every nuclear process, no matter how leak tight, emits small amounts of process material
   c) The IAEA has limited access to locations under the comprehensive safeguards agreement
   d) All of the above

Lecture 10: Types of Nuclear Reactors and Their Safety & Security

1. What is the isotope used for nuclear fission?
   e) Iodene-131
   f) Uranium-235
   g) Caesium-137
   h) Carbon-14

2. In a nuclear power plant, water is used as,
   e) Coolant and Fuel
   f) Fuel and Moderator
   g) Moderator only
   h) Coolant only

3. What is NOT a step of nuclear safety,
   e) Stop
   f) Cool
   g) Delay
   h) Confine

4. What is the energy conversion happening in a nuclear power plant?
   e) Nuclear → Chemical → Kinetic → Electric
   f) Nuclear → Thermal → Kinetic → Electric
   g) Nuclear → Kinetic → Thermal → Electric
   h) Nuclear → Thermal → Chemical → Electric

5. What is the IVth generation NPP model,
   e) BWR
   f) GFR
   g) BWR
   h) CANDU

Lecture 11: Type of Accelerators and Their Applications

1. DC high voltage technique is used for [].
   a) Electrostatic accelerator
   b) Linac
   c) Cyclotron
   d) Synchrotron

2. RF frequency used for medical electron linac is [].
   a) 2-9 kHz
   b) 2-9 MHz
   c) 2-9 GHz
   d) 2-9 THz

3. Energy of electron linac X-ray source for cancer therapy is [].
   a) 6 eV
   b) 6 keV
   c) 6 MeV
   d) 6 GeV

4. Energy of proton cyclotron and carbon synchrotron for cancer therapy is [].
   a) 200-300 eV
   b) 200-300 keV
   c) 200-300 MeV
   d) 200-300 GeV

5. Key technology of portable electron linac X-ray/neutron source is [].
   a) higher RF frequency technology
   b) superconducting magnet
   c) laser technology
   d) optimization of layout

Lecture 14: Radiation Education Thinking from Fukushima

1. Choose the one with the shortest length from the following options.
   a) 0.001mm
   b) 1×10^{-6}m
   c) 0.05μm
   d) 100 nm

2. Fig. 1 shows the radiation air dose rates in each region in Fukushima Prefecture. What is the unit of numbers? Choose one from the following options
   a) Bq
   b) mGy
   c) μSv
   d) μSv/h

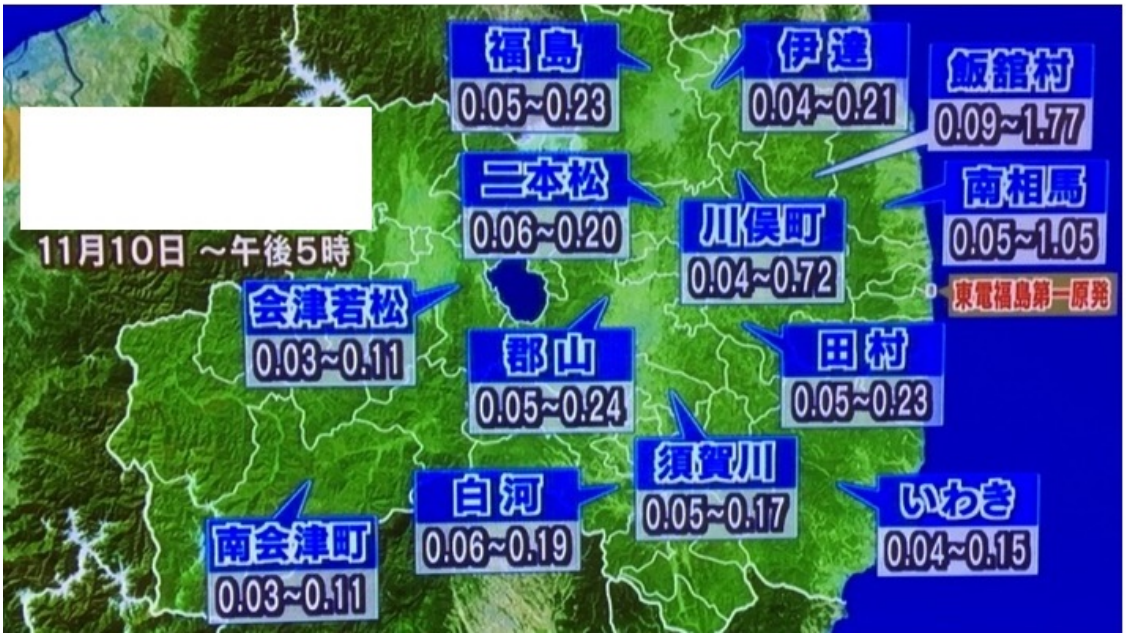

Figure 1: Radiation air dose rate in Fukushima Prefecture on Nov. 10, 2018

3. Figure 2 shows the photographs checking the radiation dose of the food for school lunch. In Japan, radioactive cesium is required to be 100 [ ] or less as a reference value of food. Choose any unit underlined from the choices.
   a) Bq/kg
   b) mGy
   c) μSv
   d) μSv/h

Figure 2: Photographs checking the radiation dose of the food for school lunch

4. Figure 3 shows that experimental cultivation using radioactive material-containing soil is carried out near TEPCO Fukushima Daiichi Nuclear Power Station (1F) that caused the nuclear accident. Why is the worker masking in Fig. 3? Choose the reason from the following options.
   a) To prevent radioactive substances from entering the body
   b) To hide their identity
   c) To alleviate symptoms of hay fever
   d) To prevent radiation from hitting their body

Figure 2: Pictures showing experimental cultivation near 1F

5. Why is the worker wearing white clothes (Tyvec suits) in Fig. 3? Choose the reason from the following options.
   a) To prevent radioactive substances from sticking to their body
   b) To prevent getting wet by the rain
   c) Because of the cold weather
   d) To prevent radiation from hitting their body

Experiment 1a: Cloud Chamber Observation

1. One of the particle detecting device used for visualizing the passage of ionizing radiation is a [ ].
   a) mist chamber
   b) fog chamber
   c) cloud chamber
   d) haze chamber

2. In a cloud chamber, thick clouds with a length of several centimeters are [ ].
   a) Tracks of α ray
   b) Tracks of β ray
   c) Tracks of γ ray
   d) Tracks of Cosmic ray

3. In a cloud chamber, thinly crushed clouds like lint are [ ].
   a) Tracks of α ray
   b) Tracks of β ray
   c) Tracks of γ ray
   d) Tracks of Cosmic ray

4. The half-life of 220Rn is about [ ].
   a) 55.6 seconds
   b) 55.6 minutes
   c) 55.6 hours
   d) 55.6 days

5. One of the cloud chamber that does not require coolant is a [ ].
   a) Dry ice cooling type
   b) Liquid nitrogen cooling type
   c) Peltier cooling type
   d) Dice cooling type

Experiment 1b: Illustrating Radiation Properties Using a Hand-made Air GM Counter

1. What kind of detector is a GM counter?
   a) Semiconductor
   b) Scintillator
   c) Gas
   d) None of the above

2. Which of the following information cannot be obtained with a GM counter?
   a) The number of radiation counts
   b) The energy of the radiation
   c) The inverse square law
   d) The radioactive decay

3. What type of pattern is common to radioactive decay and radiation shielding?
   a) Exponential
   b) Hyperbolic
   c) Linear
   d) Parabolic

4. Which of the following materials used in the experiment is the most effective as a shield?
   a) Aluminium
   b) Lead
   c) Stainless steel
   d) Plastic

5. Why was the thoron gas placed inside the GM tube in the radioactive decay experiment?
   a) Alpha particles have low energy
   b) Alpha particles have low penetrating power
   c) Alpha particles have low ionization power
   d) None of the above

Experiment 2: KIND-pro experiments for environment survey, shielding and distance, calibration

1. KIND-pro can survey a(n) [ ] ray.
   a) α (alpha)
   b) β (beta)
   c) γ (gamma)
   d) n (neutron)

2. The estimated value of worldwide average annual exposure to natural radiation sources is 2.4 mSv (Cosmic Radiation: 0.39 mSv, External Terrestrial Radiation [ ] mSv, Inhalation : Inhalation : 1.26mSv and Ingestion: 0.29 mSv).
   a) 0.38
   b) 0.43
   c) 0.48
   d) 0.53

3. NORM is an abbreviation of [ ].
   a) Not only Radioactive Materials
   b) New Official Radioactive Materials
   c) National Organized Radioactive Materials
   d) Naturally Occurring Radioactive Materials

4. NORM is included the radioactive materials of Uranium Series, Thorium Series and Potassium-[ ].
   a) 39
   b) 40
   c) 41
   d) 42

5. The distance is separated 2 times, then radiation external exposure becomes 1/4. The distance is separated 3 times, then radiation external exposure becomes [ ].
   a) 1/4
   b) 1/6
   c) 1/9
   d) 1/12

Please circle the opinion that most closely matches your own.

How satisfied are you with this lecture's contents?
(1:poor 2:satisfactory 3:good 4:very good 5:excellent)

How satisfied are you with this lecture's power point presentation & materials?
(1:poor 2:satisfactory 3:good 4:very good 5:excellent)

How satisfied are you with this lecturer's explanation?
(1:poor 2:satisfactory 3:good 4:very good 5:excellent)

How satisfied are you with the time allocation for this lecture?
(1:poor 2:satisfactory 3:good 4:very good 5:excellent)

In regard to this lecture, Please give your own opinion on the following :

What do you think are the possible questions that you can expect from students?

What is it you want to know more in this lecture/topic?

Please feel free to give us any other comments and suggestions.

Thank you for your cooperation

Additional Questions

Was the answer of the question familiar with you before this workshop? Did you have the relating knowledge before the lecture in the WS? Please fill the blank with one of these.

Yes, I had the relating knowledge before this workshop. → **Y**
No, this lecture was a good chance for me to get the knowledge. → **N**
I could NOT answer the question before this WS, and even now I can NOT identify the right answer. → ?

No.	Theme	Q1	Q2	Q3	Q4	Q5
1	application					
2	physics					
3	biology					
4	measurement					
5	social					
6	movies					
7	protection					
8	waste					
9	safeguard					
10	reactor					
11	accelerator					
14	Variety class					
E1a	Cloud chamber					
E1b	Air GM					
E2	KIND					

Final Questionnaires

What does make a big contribution to your future activities in the knowledge, experiences, personal connections etc. which you gained through this workshop?

What is your expectation for the future IAEA RAS / 0/079 TCP?

Please write your honest impressions of this workshop as a whole.

Write messages to Team JAPAN who are the lecturers, JAEA as one of the strong supporters, and Team UTokyo who served as host of TTWS 2019 JPN and.

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