

Exploration Science Outreach and Opportunities for Students and Persons with Disabilities

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Introduction

The NASA Solar System Exploration Research Virtual Institute (SSERVI) is a virtual institute focused on exploration science related to near-term human exploration targets, training the next generation of planetary scientists, and education and public outreach. As part of the SSERVI mission, we act as a hub for opportunities that engage the public through education and outreach efforts in addition to forming new interdisciplinary, scientific collaborations. In addition, we have opportunities for young researchers to participate in a variety of special programs designed to introduce them into the research field and expose them to the larger planetary community.

Outreach Activities

SSERVI actively visits classrooms to educate and inspire children to participate in STEM careers. On such program is Hawaii's annual Journey through the Universe program is a flagship Gemini public education and outreach event that engages the public, teachers, astronomers, engineers, thousands of local students and staff from all of the Mauna Kea Observatories. The program is also sponsored by SSERVI and Subaru to inspire, educate, and engage teachers, students, and their families as well as the community. Over 70 astronomy educators from observatories on Mauna Kea and across the world visit over 6,500 students in 310 classrooms at 18+ schools.

Increasing Access to Space Science

SSERVI also actively seeks the participation of persons with disabilities as STEM professionals is highly underrepresented. Very few classrooms, or schools, have adequate resources (i.e., tactile models and graphics) to accommodate students with disabilities. By increasing availability of accessible STEM related resources, particularly for those students who are Blind/Visually Impaired, and by improving the quality of teaching of these disciplines, it is likely that more students with disabilities will consider pursuing STEM careers in the future. Through two of our SSERVI teams, SEED and CLASS, we are supported this by producing three tactile guides over the last decade: A tactile guide to the Solar System, Getting a Feel for Lunar Craters and Mars Science Laboratory. Now, in coordination with SSERVI Central and NASA Headquarters, four new tactile guides are in development: Getting a Feel for Eclipses, Touch the Spectrum, Understanding Small Bodies in the Solar System and Ocean Worlds. Each of these includes an oral guide to help the user/viewer through background information and STEM content illustrated in the tactile graphics. Access to the digital text is provided via a QR code and link to SSERVI's web site: <http://sservi.nasa.gov/books/>. Kinesthetic and hands-on activities associated with each tactile help to further explain the content shared in the tactiles.

Opportunities for Young Researchers

One of SSERVI's many goals is to facilitate networking and scientific connections made between young researchers and established planetary principle investigators. To this end, SSERVI has supported the establishment of NextGen Lunar Scientists and Engineers group (NGLSE), a group of students and early-career professionals designed to build experience and provide networking opportunities to its members. SSERVI has also created the LunarGradCon, a scientific conference dedicated solely to

graduate and undergraduate students working in the lunar field. Additionally, SSERVI produces monthly seminars and bi-yearly virtual workshops that introduce students to the wide variety of exploration science being performed in today's research labs. SSERVI also brokers opportunities for domestic and international student exchange between collaborating laboratories as well as internships at our member institutions. SSERVI provides a bridge that is essential to the continued international success of scientific, as well as human and robotic, exploration.

Keywords: SSERVI, Education and Public Outreach, NextGen Lunar Scientists and Engineers group, Braille Books

Stop pretending we can measure exoplanet habitability!

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Since the first extrasolar planets discoveries in the 1990s, around 3,500 worlds are now known beyond our Solar System. Roughly one third of these have a radius less than twice that of the Earth, leading to the tantalising question about whether we have found a planet that can support life. To prioritise potential candidates for follow-up studies, metrics have been developed to sub-select planets most likely to have detectable signs of life. Unfortunately, these metrics are frequently misinterpreted --both by the popular press and sometimes in scientific literature-- to be a quantitative measure of planet habitability. Such a measure is currently impossible: the conditions relating to detectable habitability are those on the planet surface, but our measurements are restricted to typically two bulk properties. Combined with the fact that our single example of an inhabited planet makes it impossible to judge how variations in planet properties will affect habitability, this makes the use of such metrics pseudo-science. Misunderstandings have potentially serious consequences, from harming the credibility of the field to risking public interest that can lead to a drop in available funds for future missions. As a community, we must therefore plan to watch our language.

Keywords: Exoplanets, habitability, outreach

Scientific evaluation on geomorphological topics in Japanese geoparks

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Geomorphological topics are likely to be misunderstood of many geoparks in Japan. Especially, process geomorphology is rarely interpreted in geoparks where landscapes are controlled by weathering, erosion, transportation and sedimentation. In addition, extinct theories seem to remain in interpretation of geoparks. These problems are common to many situations of geoscientific outreach. This presentation reports and discusses geomorphological interpretation in cases of “landslide” and “uplifted peneplain” in TV programs “buratamori-Okinawa” and “buratamori-Amami” produced by NHK.

Keywords: Geomorphology, Geopark, Outreach

"Kirishima Geo-club" - An educational program for understanding natural history using the Kirishima geopark, Japan

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We will introduce the natural science course for elementary school students in Kirishima geopark. "Miike Miyazaki Nature House for Youth" has been offering open lectures "Kirishima Geo-club" in the Kirishima Geopark. This program contains not only lecture in the room, but also field excursion. During the field excursion, scientists explain the eruptive history of the Kirishima volcano and its mechanism of eruptions, showing land features and outcrops, while scientists also describe the ecosystem formed by the animals and plants there. Students come to understand through the program that the natural environments of the southern Kyushu exist as the result of the destruction by volcanic eruptions and subsequent regeneration. The lecture includes a study of volcanology, not only from aspects of earth science, but also as a part of the observation of nature as a whole, and comprehension of the volcano by students becomes quite high. The course has enjoyed popularity each time, and many students have come repeatedly.

Keywords: Kirishima geopark, educational program

Building stones as an introduction to geoscience

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Demand for outreach activity seems increasing nowadays. We actually have a lot of opportunity to talk to high school students or common people. Very little number of students in Japan learn about earth science in high schools, especially not if they desire to study science or engineering in the university, because of the entrance exams. Physics and chemistry are the more important subject they study during the high schools. Earth science is a kind of applied science and it is considered that there is no time for the science and engineering students to learn application. To maintain the field, it is essential to let as many students as possible know about the earth science. We must invite young students to earth science, to ensure that our investigation to earth becomes sustained and develops to benefit our future.

Stones are handy for outreach activity indoors. It is not always possible to take people outdoors for just a short outreach lecture. Stones are used almost in the raw, so it is easy to imagine how they occur on the surface of our earth even in hand samples. Stones are also popular "natural" material and the samples are touchable. Stones are durable and have no need to care, so they are easy to maintain and very handy to manage.

The advantage of using building stones is that they have many different aspects that different people can be interested in: architectural material, jewelry, fossil, volcano, stone carving.

Even if the stones are handy to touch and explain indoors, seeing them indoors is far less spectacular than seeing them in the field. It is good if you have experience of field trips in geology. Another drawback of building stones as outreach material is that the stones are just raw material to process for stone industry people. Stone industry people are sensitive to how stones can be attractive, or how it can be sold expensively, or how the material is damaged. Things are often economical and political, that it is sometimes difficult to talk about pure science.

Keywords: tombstone, marble, case study

Information of the educational programs of JAMSTEC

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JAMSTEC provided a boarding experience on the R/V HAKUHO MARU to the children who won prizes in the 18th Postcard Design Contest and their parents at 2–3 July 2016, in order that they had a better understanding of and deeper interests in the ocean. The winners and their parents stayed on the research vessel for two days and one night. Observation and other operations were conducted off the coast of Yokosuka City in Tokyo Bay. Their on-board experience included the guided tour of the ship (the bridge and other compartments), sampling with plankton net, observation of the sampled organisms, and so on. This program was also aimed at strengthening the partnerships with aquariums in Japan, better understanding of marine science and technology, and collection of samples useful for human resource development.

We also will introduce the other educational programs for high school students.

Keywords: Human resource development, Outreach



How to Innovate a new method for data visualization in science museums.

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Nowadays, people can access to geological information quickly and easily with the help of information technologies. However, it is difficult to recognize three dimensional distribution of geological structure without professional training of map reading. To solve this problem, several techniques were established to build up finely-detailed miniature with rapid prototyping and projection mapping.

From 2013 to 2016, this system was used for outreach and research activities in museums, schools, geoparks in Japan and training school for teachers in south-eastern Asia.

Development and evaluation of the interactive digital material in geoscience

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To progress education of Geoscience and Human Resources Development for the Earth environmental, we have been building the digital material, C3 (Cross-Cutting Comparisons; <https://darts.isas.jaxa.jp/C3/>). C3 assists beginners studying Geoscience by using the interactive interface and understanding the various phenomena utilizing the flexible charts. According to the results of the questionnaire survey of 12 and 13-years-old students, 79% of the students answered that it is easy to use and all students showed increased motivation for learning. We will present the features of the service, the evaluation, and how the feature works.

Keywords: geoscience, digital material, Web servise, Active learning, Cross-Cutting Comparisons

Public outreach and education activities using digital globe system, Dagik Earth

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Dagik Earth is the digital globe system that is used widely for public outreach and education activities of the Earth and planetary science. Digital globe is a powerful tool to present the Earth and planetary science data with exact shape, and make audiences understand it intuitively. There are several large-scale digital globe systems, such as Geo-cosmos of Kagaku-miraikan, Japan, and Science-On-a-Sphere of NOAA, USA. Dagik Earth is a simple and low-cost system that can be used for exhibitions and classes. Several research institutes have utilized it for permanent exhibitions in their institute, booth exhibitions in meetings, and public outreach events. Dagik Earth is widely used in schools and science museums. The Dagik Earth materials of the cutting edge scientific results can be developed by research institutes for their exhibitions, and used also in classrooms and science museums. The current status and problems of the public outreach and education activities in collaboration among scientists, science museums, and schools will be reported in the presentation.

Keywords: Digital globe, Science education, Science exhibition

Development of 4D Earthquake Visualizer - To deepen the understanding of Kumamoto Earthquake -

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Japan is a country located at the plate convergence zone with frequent earthquakes. As even after 3.11 Higashi-Nihon earthquake in 2011, several M6-class earthquakes such as Kumamoto, Tottori and recently Fukushima have occurred in and around Japan, seismology has been the study field of broad interest.

Since earthquake is a phenomenon caused by the slip with fracture along the underground fault plane, it is desirable to understand the fault plane in three dimension. Although for the past several decades mass media have expressed epicenters with single "X" marks, fault planes of earthquakes actually have finite area. While the fault plane of the 3.11 earthquake, for instance, is estimated to be ~100,000 km² (~500 km north-south and ~200 km east-west), the media reported as if one "X" mark near Sendai was the point where the event took place. Further, it is also important to understand the dip angle of the underground fault plane since the focal mechanism of an earthquake affects the seismic intensity of the affected area.

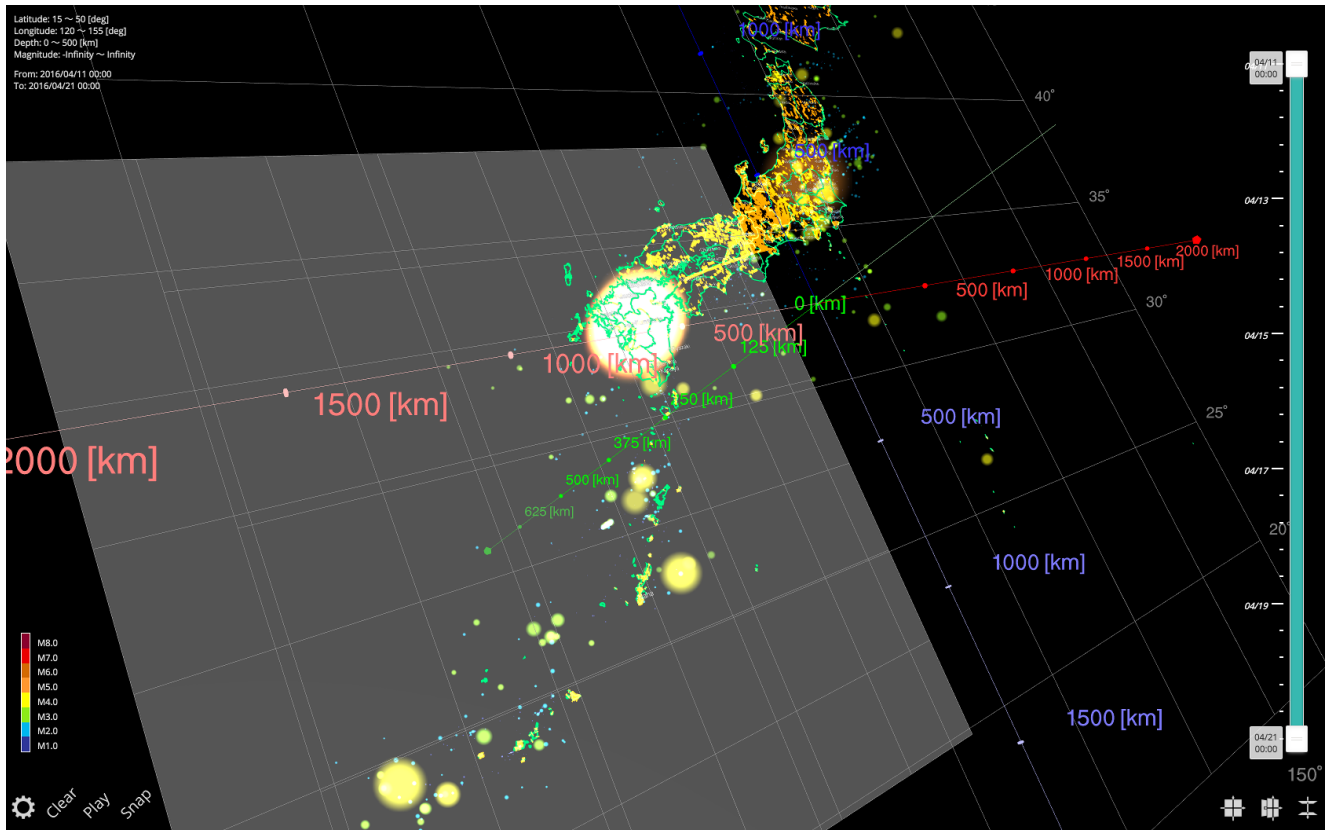
In this way, strong needs were recognized for the comprehensible visualization of information on earthquakes and touch UI to intuitively understand earthquakes in both the research and media front. It has been difficult to grasp the underground fault planes in three dimension due to their invisibility caused by technological immaturity of hardware and software. For this purpose, expensive, download-to-local specialized software has required sophisticated software/coding skills.

In order to solve these issues, LIVEARTH, Inc., the startup with cutting-the-edge visualization technology partnered with Kawai Group of Global Seismology Laboratory. Our joint research resulted in the development of innovative 4D earthquake visualization "shingen". Thanks to progress of digital hardware and software infrastructure such as faster chipsets and 3D data processing library, "shingen" makes it possible to more accurately understand and estimate the underground fault planes.

Now, LIVEARTH and Kawai Group have been closely working with academia and mass media to prepare solutions to better understand and communicate earthquake visualization to the public.

In practice, we used "shingen" in earth and planetary science class of the University of Tokyo on July 4/5th, 2016, and received various well-thought-out research reports from students.

Keywords: earthquake, hypocenter, 4D visualization, fault plane, educational tool, class



Compile a children's encyclopedia -what is needed for?

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Case study to publish a children's encyclopedia of Rocks, Minerals and Fossils will be introduced. Shogakukan's encyclopedia for childrens NEO of Rocks, Minerals and Fossils published in June 2012. The author concerned with the compiling and editing of the Rocks part of the encyclopedia. The remarkable point is zoomed photographs of rock-forming minerals, for example, to show the difference of reflecting light color on cleavage of mica and hornblende crystals in the rocks, to recognize the points for identification of rocks. There seems to be necessary to make simple useful guide for rocks in some Geo-Park in Japan not only for children but adults. Some hint fo edit guide will be proposed.

Keywords: pictorial encyclopedia, earth science education, rocks

Make science of Japan an attractive with visuals - Initiatives of Scientific Illustration for Geoscience -

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Scientific Illustration has a role to illustrate science and attract (science visual communication). Expert knowledge is indispensable for drawing scientifically accurate illustrations. But, The existence of scientific illustration in science of Japan has not been recognized/disseminated. Today, science visual ability is indispensable for international research of science. In addition, Outreach activities linking science and society are also emphasized. It is clear that science visualization is very important. So, I have that Geo-Scientific Illustration specialized in geoscience can be done in Japanese science. I began to challenge workshops for geoscience and classes for junior high and high school students. I will introduce our past activity reports and future developments.

Keywords: Geo-Scientific Illustration, science visual communication, science of Japan

Analog experiments of various phenomena around volcanoes: flank instability, crustal deformation, fault, tsunami, etc.

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Analog experiments are useful for outreach program. We cannot see the inside of a volcano directly, though various phenomena are caused by underground events. Various phenomena on volcanic process are generally dangerous. Analog experiments are useful to understand various volcanic processes safely, unlike real phenomena. We can also learn the basic mechanism. I will present various analog experiments on caldera collapse, flank instability of a volcano, topographic effects on tsunami, various faults, etc. These experiments were carried out at elementary or junior high schools, science museums, the open house in AIST, and lectures of university.

Keywords: Analog experiments, caldera collapse, flank instability, crustal deformation, fault, tsunami

Active learning on seismology and disaster prevention for university students: making illustration and picture story

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Active learning followed general lecture on seismology and tectonic geomorphology for undergraduate students of the Chiba Institute of Science, Japan, to promote passive students' action and interactive communication among student and teacher. Students read a paperback about seismology and drew a illustration of their own opinion. Illustration was sent to the book author, and reply illustration was received from the author. Picture story about earthquake and tsunami was made as a method of disaster prevention education, and played in the classroom. Students showed positive evaluation for active learning above.

Keywords: Active learning, Illustration, Picture story, Earthquake, Disaster prevention, University

Earth science education through the preparation of mineral pigments

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I tried the making of pigment (mineral colors) as an earth science experiment for primary and secondary students. A tool and the workflow are as follows,

- Hammer and anvil, iron mortar, porcelain mortar, wood glue, palette, drawing paper, paintbrush, weighing paper, soil color chart, worksheet for review of the work, microscope.
- The sample for pigment; limestone, volcanic glass, pumice, scoria, fossil shells, coal, weathering soil, lazurite, turquoise, malachite, red coral, fault gouge.
- wear down by hammer, iron mortar and porcelain mortar -> check for particle size by microscope and wear down by porcelain mortar again if coarse -> add wood glue after 5 times dilution with water, then make a paint paste form -> record the characteristic of the sample and the work to worksheet -> challenge some simple sketch.

Keywords: experimental workshops, elementary education, secondary education, regional specialization, tephra, soil color

The development of teaching materials in simulating the dilemmatic decision-making processes in the event of a disaster

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The “4-frame cartoon,” a teaching material developed by the writer of this paper, was inspired by the disaster prevention drills held at Minami Sanriku-choritsu Utazu Middle School. The “4-frame cartoon” takes a gaming and exercise-based learning approach, and is carried out as a workshop. Participants must imagine themselves taking part in managing the evacuation sites. They are to collaborate with others in facing the dilemmatic situations that occur. The first 3 frames illustrate the proposed dilemmatic situation, and the 4th frame is left blank for participants to fill out with a dialogue targeting the general public. This dialogue is to be the result of a consensus-making process amongst participants, in coming up with a solution to the situation.

This paper will discuss the effects of this “4-frame cartoon,” mainly by conducting speech analyses of the workshop’s participants. Out of over 20 variations of the “4-frame cartoons” that exist, this paper will mainly examine the “role-based 4-frame cartoon.” The workshop is composed of an introductory lecture, group work, and presentations. During the group work time, a deck of “quote cards” are distributed to each group. Written on these cards are important information for their specific role, based on past disasters and incidents that actually occurred in evacuation sites. Participants will thus result in reaching a consensus by taking real-life situations in consideration.

Ever since the 2011 Great East Japan Earthquake, the demand for conducting disaster prevention education at schools and local communities has only increased. Meanwhile, learning materials are overwhelmingly lacking. Considering the fact that there has been almost no discussion on the means of evaluating existing materials; in accordance with Yamori (2007), and by classifying existing materials based on Atsumi (2006), this study aimed at evaluating the “4-frame cartoon” as a learning material for disaster prevention education.

Keywords: disaster prevention education, teaching materials, consensus-making

Strategy of risk communication on empowering disaster prevention actions

~ A case study of Mashima Elementary School ~

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After Great East Japan earthquake, the significance of education for disaster prevention is confirmed further and improvement of current education is highly required at every school. On the other hand, countermeasures against disaster at each household depend on the awareness of parents and so the level of preparedness resulted in large variation compared to that of schools. This represents a severe problem for protecting children's lives because they spend more time at home than at a school. Therefore, education for disaster prevention at school should be designed to have effects over school kids' parents. This research will discuss a case study of Mashima Elementary School, located in Nagano prefecture. At this school, disaster prevention education was carried out in the means of action research beginning in July 2015 and going into the academic year of 2016. The practice aimed at not only empowering children to save their own lives, but for them to influence their families in taking preventive measures. In particular, the practice consisted of delivering disaster prevention lectures once or twice a year, distributing newsletters every month, and using the newsletters to facilitate monthly disaster prevention classes. As a result, the execution rate of people taking actions such as securing their furniture, significantly increased from approximately 10% to 50%.

As a result of analyzing qualitative data, this research also proved that the data obtained can be analyzed with the framework of the theory of "Communities of Practice" (Lave & Wenger 1991; Yamori, 2006). This effectively suggests new criteria within the field of disaster prevention education. Moreover, this study discusses instrumental and consummatory values implicated in taking part in disaster prevention activities. The utmost goal is to be prepared for coming disasters and to minimize future losses. However, people who take part already appeared to also seek value in being fulfilled.

Keywords: disaster prevention education, risk communication, disaster prevention actions

The Implementation of Short Drills as a Means of an Effective Educational Approach to Disaster Prevention

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The occurrence and aftermath of the 2011 Great East Japan Earthquake revealed the significance of taking an educational approach to disaster prevention. Despite the urgency for improvements in taking such approaches, many schools have yet to change.

This research will discuss a case study of Shirahata Elementary School, located in the City of Yokohama. The research began in June 2016, aiming at practicing and implementing effective measures of disaster prevention education. One of the measures of particular focus was the “short drill;” an alternative to conventional evacuation drills lacking in effectiveness. In the short drill, students are divided into two groups and are required to observe each other in reacting to the Early Earthquake Warning. Afterwards, upon the teacher’s facilitation, students are to give constructive feedback to each other regarding their evacuation actions. The short drills were conducted in varying situations intensively during a short time period, and were designed to nourish students’ abilities in making appropriate judgments that would lead to protecting their lives at the event of a disaster.

As a result, various changes suggesting the effectiveness of the short drills were observed in both students and teachers. Students’ evacuation behaviors increasing in speed and highly reasoned judgments, students’ awareness of preventive measures increasing, teachers discovering that there is no right answer to disaster prevention education--are all examples of these changes. This research will aim at revealing what these changes may imply in disaster prevention education in its entirety, by carefully analyzing how they influenced the school’s curriculum.

The utmost goal is for society as a whole to be prepared for coming disasters. In the presentation, we would like to discuss what the empowerment of children through education may imply in achieving this goal.