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LETTER FROM THE EDITOR

Dear friends!

For over a year, circumstances have kept us apart, and we have not been able to meet in person. Regardless of this, we have managed to communicate online. The following is the latest edition of JOSE, the main informational publication of our organisation.

The main goal of the Journal is to popularise the MILSET activities among the participants and the public. The Journal covers important areas such as popularization of science in the world, main development tendencies, MILSET events, the MILSET history, and some interesting practices of science education.

While the borders are closed, it is especially important that we maintain the MILSET bond. We can rely on each other, continue discussing the same issues, and look for new ways of developing the scientific and technical creativity of young people.

Due to our confinement, meetings have become more accessible since we may avoid traveling, although nothing can replace personal communication and perception of nature and culture of other countries. Recently, many representative conferences have been held in

different countries of the world, in which children have taken part. These are the online conferences and science fairs in Canada, Mexico, Indonesia, Spain, Tunisia, and Turkey, among others.

Between 2020 and 2021, significant events have been organized such as the World Virtual YCC, and the MILSET Vostok Online Round Table "International STEAM programs for youth in the time of closed borders". In the latter, our friends from Chile, Indonesia, Kuwait, Mexico, Russia, Poland, Tunisia, and Turkey, presented their ideas, strategies, and technologies on how to organize International STEAM events in the new conditions we are experiencing due to the pandemic. The main content of the present edition includes materials from such representatives.

We also think that our mission has to do with providing readers scientifically reliable information. This is especially important nowadays, when the truth of facts is occasionally verified by the opinion of the majority, and semi-scientific facts are often disseminated in society.

We are grateful to Jean-Claude for reminding us about the past of MILSET, which set our movement tendencies towards the future. Time passes by and public opinion changes, but cooperation and interaction are eternal MILSET values, we must refer to them again and again.

Currently, developing technologies for distant communication, keeping participant's attention during online events, and organizing online teamwork have become essential.

I encourage you to cooperate with our friendly editorial staff!

THE COLLAPSE OF EDUCATION SYSTEMS: THE OTHER REAL THREAT OF COVID-19

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Abstract

Before the beginning of the health crisis, the resources and students needed to ensure education were mainly found in formal education, at schools and university. A singular situation was induced by COVID-19: The entire formal part of teaching had to be done remotely. Such condition has exposed the different levels of digital precariousness suffered by poor people, in poor countries, but also in rich countries. Not only we discovered that education problems and pathologies are deeper, more complicated, but they need adapted solutions urgently.

Keywords: *Education, School, COVID-19, Digital*

The UN World Summit of the Information Society (WSIS – Geneva 2003; Tunis 2005), in which MILSET took part actively, aimed to find resilient solutions made possible by strong collaboration among north-south and private-civil society in order to remedy the digital fracture, which deprives entire countries of access to digital modernity. Post WSIS was characterized by an increase in the use of computers and the Internet, but unevenly and very disproportionately. The numeric fracture is yet present and can be observed not only between countries and regions of the world, but within the same country, including developed countries. The situation today is that the different uses of the Internet are present in several trades and private services, but much less in public services, and, curiously, even less in education, as if schools wanted to keep themselves out of the "business".

Before the health crisis (February/ March 2020), the resources needed by pupils and students to ensure their education were mainly found in formal education at schools. Private lessons were also common, and websites on the Internet would take students' time in such activities like games, videos, music, and the like, up to toxic degrees. In such case, the formal education then served as a reference for the non-formal. Furthermore, there was very limited online education initiated by teachers.

AND SUDDENLY THE COVID-19 WAS THERE…

The sudden closure of educational and training institutions generated by confinement constitutes an unprecedented situation imposed by the health crisis of COVID-19. The entire formal part of the teaching had to be done remotely. Suddenly, "the school was no longer at school, but at home". Formal schools and universities were thus destabilized. The technical and pedagogical problems that this situation has posed are numerous and are yet far from being solved. Teachers' professional practices are at stake. Not only has The COVID-19 crisis also exposed the different levels of digital precariousness suffered by poor people in poor countries, but also in rich countries such as France or the United Kingdom.

A significant number of girls, boys and adolescents from low-income families and rural areas cannot benefit from online education, because they do not have access to computers and the Internet, and because policies and international meetings, as the WSIS 2003/2005, are unable to bring solutions to their precarious situation.

In order to mitigate the short and long-term impact of school closures and ensure lifelong learning, many countries have adopted distance teaching mechanisms. However, the results are far from being sufficient and satisfactory because the majority of learners find it hard to get distance courses. This is mainly the case for children living in isolated rural areas, who do not have access to the Internet, television and sometimes even radio. In many African, Asian and South American countries, distance learning has so far been rather hypothetical.

In European countries, the situation is certainly less worrying, but there are some drawbacks. Not all students have adequate Internet access at home, except by their cell phones (which is sometimes only 3G). Above all, cell phones are not a suitable working tool since they are more commonly used for games and communication. Many do not have a printer or the financial means to renew expensive cartridges. Another problem happens when there is

only one computer in the family home, not necessarily a new one. Parents, even older children, work remotely and there may be several schooled children. For this reason, it is necessary to organize the part-time use of that one computer for everyone, and it doesn't always work out at its best!

DIGITAL INSECURITY, INEQUALITY OF MEANS, INEQUALITY OF OPPORTUNITIES

Because of inadequate Internet speed and/or an insufficient purchasing power, thousands of primary and secondary school learners have been denied the opportunity to follow their lessons at home. This situation may last longer, depending on how the crisis unfolds.

Two main consequences have appeared: A highly discriminatory environment, and a brake on the fight for equal opportunity. Globally and locally, the poorest people and families are the first to be affected. Thus, half of the students in Sub-Saharan Africa were unable to benefit from distance schooling and, overall, it is mainly schoolchildren from disadvantaged social classes who dropped out of school during confinement.

The UN also warns that even if students have the appropriate hardware tools at home, many factors can interfere with their learning at home, like taking care of younger brothers and sisters, doing housework, or not finding the necessary support at home to use technology. These are some obstacles to a good quality teaching/learning.

THE MOST WORRYING POINT IS INEQUALITIES AMONG PUPILS

Inequality is already present in the education systems. Differences widen those inequalities, because parents are not on economic, nor social equality to help their children and guide them. Many of the poorest families no longer believe in school to ensure the future of their children. Students with special needs do not have the human resources that the inclusive school made available to them in the classroom. They also lack help at home due to confinement. They are therefore likely to be penalized the most. Many students do not even enjoy their daily lunch due to the closure of schools, not only in poor countries, but even in the suburbs of London.

COVID-19 pandemic disproportionately affects the most vulnerable populations, the poorest children, and young refugees and migrants. It also exacerbates gender inequalities, with an increase in cases of child abuse, exploitation of children in agricultural and other labour, gender-based violence, forced child marriages, teenage pregnancy, and female genital mutilation. In addition, as vulnerable families in developing and poor countries experience loss of income, some may also be less likely to send their children back to school, especially after school closure.

REAL PROBLEMS AND FALSE SOLUTIONS

First, the initial teacher training remained traditional in many nations such as Tunisia and the Maghreb countries. Teachers were not trained properly, and even less to digital practices**.** Second, teaching during the pandemic crisis highlighted the issue students' autonomy over their learning. Indeed, while they are used to being supervised and guided, they are not independent in their use of technologies, particularly those whose parents are not available to support them. Finally, students also need personalized feedback (which is what they might miss

the most), and real evaluations of their learning. Online reviews appear timid and limited. Exams and competitions are a similar story.

Keeping a bond is essential. However, a specific pedagogy for distance education remains to be found, as long as schools remain closed, or with the threat to close again. Most governments have failed to provide effective solutions in the short, medium, and long term, some of which may be counterproductive. In Tunisia, for example, the government has opted for group schooling and work-study every other day. Thus, within the same class, students will go to school 2 days a week, then 3 days the following week (and vice versa). As a result of that, no real adjustment to the content of the programs has been adopted. On the other hand, nobody thought about the children's status off school. In many families, both parents are often at work, which leads children to the street, crime dangers, and road accidents.

INTERRUPTION OF SCHOOLING: A DANGER FOR TODAY, TOMORROW AND THE DECADES TO COME

An interruption of schooling carries short, medium, and long-term risks on the development, well-being, and protection of children. There are also lasting consequences on social and economic recovery on resilient people and on sustainable development. Education cannot wait until crises are over. It's now (or probably never) the moment to support education, at all levels, primary, secondary, university and professional!

The lack of education has also immediate effects such as the following:

a) An increase in the number of school dropouts (among the most vulnerable are girls, those affected by conflict and among internally displaced persons).

b) A decline in learning as in loss of school years.

c) An increase in child protection problems such as violence, abuse, early marriages, psychological distress.

d) A lack in younger generations' basic qualifications and skills for life, job prospects, and continuing education (lost generations).

e) A decrease in resilient individuals, with economic repercussions.

Henrietta Fore, UNICEF Executive Director, affirms: "For at least 463 million children whose schools have closed because of COVID-19, distance learning did not exist", "the great number of children number whose education has been completely interrupted for months is a global educational emergency. The repercussions could be felt in economies and societies for decades to come".

AFTER THE CRISIS, FEW THINGS WILL BE AS BEFORE

The COVID-19 crisis has continued for almost two years and the time is running out to prepare for its end, even if we do not know the precise moment. The pandemic is dramatic in its scale, its gravity, and the speed of its spread. Yet, what is happening was predictable and will happen again in the future. Other similar situations will happen such as civil wars, severe weather, and major unrests. In the future, there will be other pandemics, and they will deprive students and teachers from joining schools and universities!

WILL THE COVID-19 HAVE THE MERIT OF TRIGGERING AWARENESS OF THE FRAGILITY OF OUR EDUCATION AND TRAINING SYSTEMS?

I am not so sure. In poor countries, as well as in developed ones, "wounds" to the economy will make the will and wishes of public authorities difficult. Moreover, will public treasuries have the means to increase education budgets, and to create new credit lines dedicated to Internet and digital educational innovation? There is a real urgency. Let us not commit, once again, the mistake of collective lack of preparation, even if the heavy administrative bureaucracy will do everything to work on re-establishing "normality", preferring the comfort of customs and routines, to innovation and creation.

HOPING SO, AFTER THE CRISIS, THINGS DO NOT COME BACK AS BEFORE

Confinement has shown one thing: digital technology is vital. It is obvious that, from a social, educational, and pedagogical point of view, as well as from economic considerations ***no digital, no life.*** Paradoxically, never has the digital world division been so evident, so impactful, so revolting. It is therefore imperative that digital innovation and creativity, accelerated by this crisis, serve as catalysts to make education systems more modern, but also more just, equitable, inclusive, and resilient. Priorities are in front of us, but time and budgets are counted. Let's ask ourselves three fundamental questions:

I. What lessons have we learned so far?

II. How to transform the education sector in a positive way during and after COVID-19?

III. What actions have we accomplished for achieving the Sustainable Development Goals (UN-SDG)*, and SDG 4 ** in particular? These actions must be implemented without delay, respecting the different priorities from one country to another, and from one level of education to another. Today, urgent actions need to be implemented everywhere:

a) It is urgent to reconnect with students who dropped out of school during the confinement, to help students to return to their classrooms, and to help them identify their learning needs.

b) Next, governments should develop strategies to effectively limit the risks in case schools close. They could closely monitor student's attendance, behaviour and learning progress; they could eliminate any obstacles by providing them with appropriate means such as laptops, tablets, and free internet in a secure workspace; they could prepare the school for other possible emergencies involving prolonged closure.

** The 17 Sustainable Development Goals (SDG° are a call for action by all countries – poor, rich and middle-income – to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection. More important than ever, the goals provide a critical framework for COVID-19 recovery.*

https://www.un.org/sustainabledevelopment/sustainable-development-goals/

*** The 4th Sustainable Development Goal (SDG 4): Quality Education. Obtaining a quality education is the foundation to improving people's lives and sustainable development.*

https://www.un.org/sustainabledevelopment/education/

c) More than ever, adequate, and sufficient funding for education will be needed. ***No turning back:*** financing education should remain a priority to modernize pedagogies and learning methods, as well as to achieve, in time, UN-SDG point 4.

d) NGOs and civil society must remain united around the promotion of the right to free, quality, and inclusive public education for all. Advocates for the right to education must remain vigilant and ensure that governments do not divert resources allocated to education for other purposes, and that aid allocated to the sector is maintained.

e) Powerful mechanisms such as cutting arms budgets (including those for police repression) and turning debt into investment in digital education also need to be explored.

f) Teachers need to promote students' autonomy by exploring the possibility of making the school environment more flexible in order to allow students to make more choices in relation to their learning.

g) The idea that what is learned at school is boring and out of date spreads among learners, as well as their parents. Several international organizations, including the OECD***, have called for "giving meaning to learning" through updated curricula that are more stimulating and interesting for students.

Finally, through this article and its content, we wanted to trigger the debate on an acute problem, affecting the educational system, considered, together with the health system, the most vital sectors of society, for the present and the future. Both have unfortunately been hit hard by the pandemic. Today, schools must make their revolution to be alive tomorrow by transforming the damage caused by the COVID-19 and take the opportunity to be better.

M. Moncef JENDOUBI – Tunisia

*** *The Organisation for Economic Co-operation and Development (OECD)*

THE EXPERIENCE OF ORGANIZING THE "NATIONAL EXPO-SCIENCES 2020 IN MEXICO"

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Abstract

- *Challenges of organising a virtual science fair.*
- *The success of a competitive virtual event.*
- *Plan a virtual science fair for a big audience.*
- *Capture the attention of the audience on a virtual model.*

Keywords: *Science Fair, Expo-Sciences, Competition, STEAM projects*

INTRODUCTION

A year ago, the whole world was facing an entire new reality. The pandemic and the quarantine measures completely changed our lifestyle. Still, above all, we did not know precisely how to proceed in our regular activities, especially for those who work organising events. How could we organise ourselves in these new conditions of isolation and with closed borders? How could we proceed with our daily activities?

At first, we thought that we only had to wait and then continue with our routines as we had done before, but then, it became clear that these changes would stick with us for a long time. Then, we all started thinking about how we could continue to learn, to live our everyday lives, and to organise our events in this new reality. After almost two years, we all have come up with new ideas, using new technologies and strategies.

Those ideas entail facing the coming challenges, learning what others have been working on, inviting speakers from different parts of the world to talk about events they organised, sharing those speakers' experience, and discussing common trends and unique practices.

MEXICAN EXPO-SCIENCES

We have held 18 editions since 2003 in Mexico, but I would like to tell you how the National Mexican Science Fair "Expo-Sciences Mexico 2020" worked. At the beginning of 2020, as we had a lot of participation, we began to organise 42 selective events in different states, which selected the best 500 scientific projects to participate in the National Fair. Three hundred and fifty members of the Jury chose the finalists from around 2000 participants from 1500 schools, including international-guest participants from about 17 countries. The event was divided into 11 areas of participation and five categories that go from kindergarten, elementary school to university students. At the end of the Expo-Sciences Mexico, the best projects got 100 accreditations to attend 42 international events.

Regarding the event structure, Expo-Sciences Mexico had a face-to-face opening, an open science fair to present the participant's projects, conferences, workshops, STEAM visits, cultural activities, special activities for international participants, and the closing and award ceremony. This event was co-organised with RED (National

Network of Youth Activities in Science and Technology), central office and a state office.

The RED team coordinates and organises all the activities from UPAEP University (the Popular Autonomous University of the State of Puebla in Mexico). Due to the sanitary measures, it was forced to close at the end of March in 2020.

GOING VIRTUAL

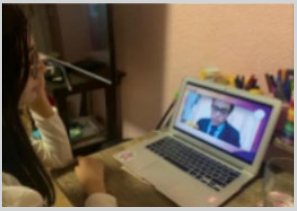
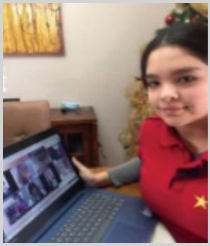
In 2020, the National Expo-Sciences was planned to be on-site in Sonora, a prominent state in northern Mexico. However, as we thought the university's closure wasn't going to take that long, we decided to continue working as usual. The situation turned worse all over the world, and we faced the big challenge to organise the event in a virtual model.

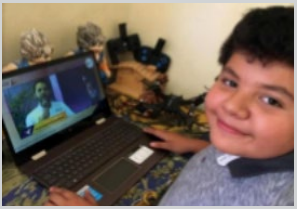
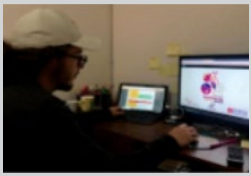
The big questions were: how do we coordinate with the 42 selective event committees? How do we carry out a virtual event that could provide all the activities we usually present to almost 2000 participants? How do we catch the attention of all of them?

After many meeting hours and a detailed analysis of the situation in each state, only three out of 32 states were not able to organise the States Expo-Sciences virtually or had to cancel. The response of the organisers and participants was fantastic, and this motivated the National coordination team to present the biggest virtual STEAM fair in the Mexican territory.

It was time then to adapt the National event to the new format and run the event for the national and international public. To make the event attractive and different, we decided to set a professional stage in a hotel in Sonora to stream the main activities live. Some activities were going to be recorded, such as cultural activities, touristic and scientific tours, conferences, and workshops. We carefully set the programme's schedule not to overload participants with activities, and we also considered the different time zones for international participation.

Honestly, we were worried about the attendance to the entire event because we could not control it at virtual events. So, we had to rely on the marketing you did and an attractive programme.

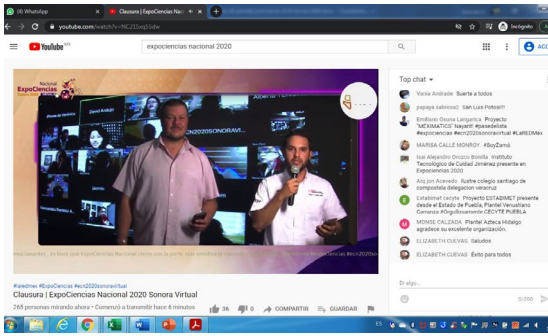




National Expo-Sciences Mexico 2021 participants

THE RESULTS

The results of the virtual event surprised us and exceeded our expectations. They also confirmed the importance of the National Expo-Sciences in Mexico. We also discovered that the public found the event attractive and enjoyed it.

- Four days of fully live streaming
- 26 activities
- 22 hours of programming
- 445 national projects
- 70 international projects
- 1,700 guests from 17 countries
- 47,496 total views
- 170,280 total users reached



It took the team many hours of planning and bringing new ideas to get to these results. Some of the activities that captured the attention were guided tours by professional presenters, like the tour to the Sonora Desert, conferences with top speakers who gave their talks directly from their research centres and took participants through a virtual tour, cultural presentations around the region and international participants, among others.

An essential asset was the registration platform that registered participants, projects, and the evaluators online. Thanks to this system, more than 300 evaluators, specialists in different areas of science, could evaluate the projects delivered in a video format.

One of the advantages of the virtual mode is that national participants didn't have to travel long distances to attend the event. Usually, participants and families must plan long trips if their state is far away from the host state, as Mexican territory is extensive. For this reason, it was easier and cheaper for them to attend online. Unfortunately, the experience from on-site events cannot be replaced. We plan to make a book compiling projects and activities and send it to the participants together with a certificate and a medal.

I hope the borders can be re-opened soon and we can enjoy the Expo-Sciences experience together. Meanwhile, you are very welcome at the next Mexican Expo-Sciences, in the north of Mexico, in Durango.

See you soon!

ONLINE CHALLENGE. OUR EXPERIENCES FROM THE E(X)PLORY 2020 EDITION

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Abstract

As you all know 2020 was very hard for all the people working on the events field. We all had to redefine our activities. And find a new way of existence. It was not easy. With this text I will try to share with you our experience. Show you the path which we went through.

Keywords: *promotion of science and innovation, young scientists, youth science contest, E(x)plory programme*

As you all know 2020 was very hard for all the people working on events organisation. We all had to redefine our activities and find a new way of existence. It was not easy. With this text I will try to share our experience and show you the path we went through.

What is E(x)plory? The E(x)plory Programme is a unique initiative promoting science and innovation as well as supporting young talents and innovators.

When the pandemic started, we knew that we had to redefine our core activities, set the new aims, and adapt them to the new reality. That was the only way to survive. That is how in March 2020 we opened a new chapter, an online chapter. We tried to show this perspective in our new motto: New reality, New possibilities, New challenges.

Our biggest success is that we managed to encourage all our partners to stay with us. Because losing sponsors was the biggest risk, that was something we were the most afraid of.

HOPIN

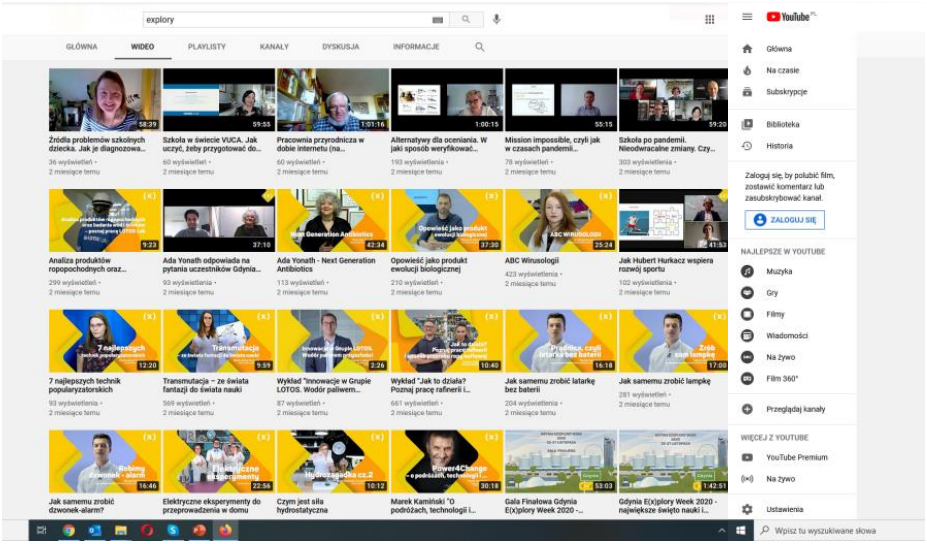
First, we knew that we had to choose a platform for online events. As you probably know there are a lot of them. Why did we choose Hopin? Because it met all our expectations. What did we need? We needed a stage to present lectures and open chats. We needed a session room with limited amounts of guests. And we needed an expo area where we could place our online materials and where we could present our partners.

Hopin has it all!

YOUTUBE!

All of us know YouTube. How did we use YouTube during our events?

YT makes our events everlasting. All the elements of our events were recorded, and we placed them on YouTube. Thanks to this platform people can watch them. The number of views is increasing every day. That is a huge benefit for online events.



LANDING A NEW PAGE

We launched a new website which gave us a chance to centralize all our activities. A landing page was the centre of our new online shape. What did we share there?

- info about upcoming events: festivals and congresses
- direct link to the registration system
- video cards recorded by the participants of E(x)plory Contest with short info about their scientific projects

SUPER STARS

We knew that the competition on the Internet is huge. For this reason, we had to do something special. That is why we decided to invite Super Stars to be part of E(x)plory.

It gave us bigger visibility.

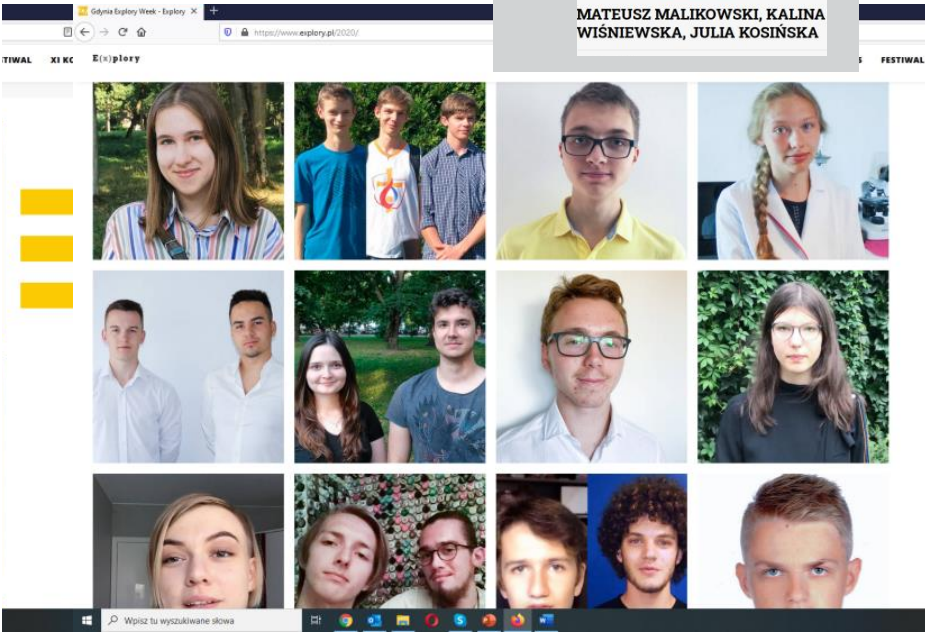
MATEUSZ MALIKOWSKI, KALINA WIŚNIEWSKA, JULIA KOSIŃSKA

OUR BIGGEST SUCCESS

We managed to transfer all our events to the internet. We did even more! We decided to add new elements to the E(x)plory programme. I, myself, ran conversations on Facebook with people working in the field of education. We have recorded a series of podcasts called “Hello science”. And all these elements have stayed with us until today.

Today we are stronger, wider, more visible and accessible for a much bigger audience.

And we look bravely to the future!



YAKUTIA INTERNATIONAL SCIENCE GAMES
YISG RUSSIA 2022

INTERNATIONAL SCIENCE GAMES 2022

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Abstract

This article introduces the concept of the 2nd International Science Games 2022 (ISG-2022). The author describes the mission and goals of this global event, its principles, structure, and format.

Keywords: *International Science Games, STEAM activities, science education, hackathons, research monitoring*

The International Science Games is a week-long festival of science-related activities conducted in a non-competitive and competitive format.

The Republic of Sakha (Yakutia), a constituent state of the Russian Federation in Eastern Siberia, launched the first International Science Games in 2018. Yakutsk, the capital city of Yakutia, hosted more than 1,500 participants from 40 countries and 11 regions of the Russian Federation.

In its initial concept, the Games followed the four-year cycle as the Olympic Games. The Republic of Sakha (Yakutia) decided to host the Games in 2022 and designated them as the ISG-2022. It is a particularly significant event for Yakutia since it coincides with the republic's centennial celebration. The government has appointed as the organisers the Ministry of Education and Science of the Republic of Sakha (Yakutia), and the Future Generations Fund of the Republic of Sakha (Yakutia).

The number of ISG-2022 participants will increase significantly due to the virtual participation added to the offline participants. The distant participation will allow students and organisations from all over the world, including those who otherwise would not have any funding available, to participate in the Games.

The ISG-2022 mission is to develop international cooperation in education and science to enrich the human potential for sustainable development goals.

The ISG-2022 goal is to create an international community of highly motivated school students, educators and scientists engaged in social well-being and developing the world's creative economy.

ISG-2022 WILL HAVE SEVERAL STAGES:

- Preliminary (January – June 2022). Participants will perform different research tasks published on the ISG-2022 website. The participation is open.
- Main Event (July 2022). It will be held in Yakutsk. It will include the Tuymaada International Olympiad, the International Research School, the International School Scientific Conference, robotics and 3D-modelling competition, hackathon, an international youth forum on global issues, and a media school. This is a face-to-face participation.
- Final (July – August 2022). It will be held in the form of science camps with project-based learning and career guidance on the lead of Russian universities.

ISG-2022 events are based on the ecosystem principle, characterised by various work formats and educational resources, interdisciplinary content, and educational paths' flexibility. In contrast to the hierarchical one, the ecosystem approach has a distributed management structure based on the self-organisation of participants and communities, supported by their mutual interest in each other.

The ecosystem approach allows every student to take part in the ISG-2022. It does not imply selectivity in the process. The primary motivation of the participants will not be a competition but an interest in collaboration and teamwork on solving global problems and self-development through access to new educational resources and opportunities.

The ISG-2022 organisers believe that this global event could be a good launching pad for self-realisation and self-determination. The winners will have an opportunity to participate in study trips and internships in leading scientific centres, and participate in high-level international scientific events.

YAKUTIA INTERNATIONAL SCIENCE GAMES
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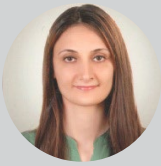

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BRING YOUNG SCIENTISTS AND ARTISTS TOGETHER WITH INTERNATIONAL ONLINE ORGANIZATION: BUCA IMSEF 2020

Abstract

Special education programs are implemented all over the world to detect gifted students and to ensure their development. Those children must keep up with the education they receive and the changing educational technologies in the world. Science and art centres in Turkey are special education centres for gifted students. Within the scope of this study, the role of science and art centres in the education for gifted students is investigated. A new education system is proposed for gifted students who need special education, ranging from kindergarten to university in Kızılçullu Science and Art Center. In addition, the national and international music and science fair Buca IMSEF is also mentioned within the scope of the study.

Keywords: *Science and Art Centres, Gifted Education, Buca IMSEF.*

BUCA MUNICIPALITY KIZILÇULLU SCIENCE AND ART CENTER

Kızılçullu Science and Art Center was established in 2019 by Buca Municipality. Kızılçullu Science and Art Center aims to teach science to young students, to discover and reveal the talents of children who have potential in different branches of art and thus bring them up as "Scientists of the Future" and "Artists of the Future".

Young people and children can apply science and technology, produce their own projects, and perform artistic activities in line with their abilities in this centre. Kızılçullu Science and Art Center, which is the first one of its kind in Turkey, provides free-of-charge science, music and social activities to the students who study and live in Buca.

In our team, Ümit Karademir is the director of the centre, Belit Karaca is a pianist and coordinates music activities. Dr. Meltem Gönülol Çelikoğlu, a physicist, and Dr. Cansu İlke Kuru, a biochemist, coordinate science and social activities in our centre. The list of activities we have in our centre are science and art lessons, Buca IMSEF International Music and Science Fair, nature camps, chorus and concerts, international entrepreneurship and creativity studies, social responsibility studies and projects, robot-coding trainings, participation in scientific projects and international project competitions, piano and solfege courses, and seminars and workshops.

Buca Municipality Kızılçullu Science and Art Center Activities

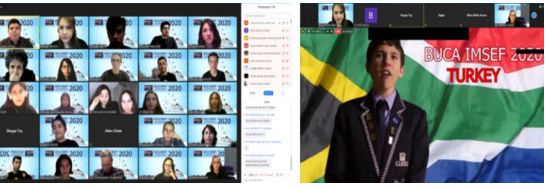
BUCA IMSEF

Buca Municipality Kızılçullu Science and Art Center organises Buca IMSEF (International Music, Science, Energy, Engineering Fair) to spread the spirit of scientific research and art to the whole world. Buca IMSEF enables young people to make social and cultural exchanges. It also brings young people from all over the world together, especially those who are open to change and interested in science, art and technology.

Buca IMSEF represents Turkey at 53 scientific and 2 music international competitions from all over the world. This is a great honour for us, and we attach great importance to our affiliated organizations. Buca IMSEF 2020 took place on December 14–18, 2020 as an online event, it was granted permission by the Ministry of National Education.

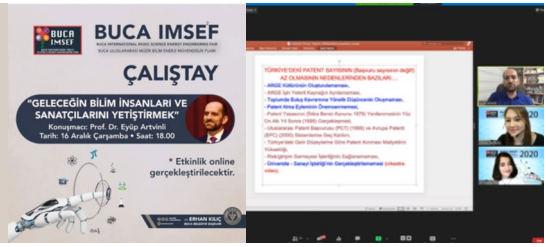
Buca IMSEF 2020 Announcement Posters

Buca IMSEF Categories



Buca IMSEF 2020 Opening Ceremony

Buca IMSEF 2020 Jury Evaluations



Buca IMSEF 2020 Workshops

Buca IMSEF was organised in the following categories: Biology, Chemistry, Physics, Engineering-Energy, Mathematics-Computer and Music. Buca IMSEF jury members were all experts in their fields and university academic in each category.

The Buca IMSEF 2020 National Category comprised 27 Cities, 65 Schools and 90 Projects. The International Category comprised 24 countries and 74 projects as finalists.

Following our schedule, we started with the opening ceremony on the fourteenth of December, continued with evaluation, workshops, and finished with our closing and award ceremony. All the activities were conducted on the Zoom platform, ceremonies and workshops were live on YouTube, Facebook, and Instagram.

Before the event, we planned testing meetings with national and international participants and informed them about all the details. In the opening ceremony, there were opening speeches by invited speakers, and a piano concert was performed. We showed promotional videos of Turkey, Izmır, Buca, and Buca Municipality and Kızılçullu Science and Art Center. We received videos from all the national and international participants on how they felt about their participation in Buca IMSEF. We shared these videos to show their excitement at the opening ceremony. In the jury evaluation, students presented their projects to the juries in the form of oral presentations on the Zoom platform. One participant also gave a live piano performance to our juries.

We organized workshops entitled 'Raising Future Scientists and Artists'. Prof. Dr. Eyüp Artvinli had a speech about 'Project Based Learning'. Dr. Monika Raharti, Director of the Center for Young Scientists and APCYS President, had a speech about 'Key factors for success in science competitions.

At the most exciting part of our event, closing and award ceremonies, we showed promotional videos of all 24 participating countries, a dance performance of our students in the centre and a brief video of Buca IMSEF 2020. The juries made separate evaluations in the national and international categories. At the award ceremony, the national participants won first, second, third awards, and Turkey representative awards to our affiliated fairs. The international participants won Gold, Silver and Bronze Medals. In addition, the AYIMI İran Journal award, which publishes its projects as scientific articles in both national and international categories, was given.

Buca IMSEF 2020 had a lot of coverage in the national and international media and many news articles were published.

With the organization of our fair as an online event, we were able to reach more people, as there were no transport and accommodation costs. Moreover, the participants got an opportunity to spend their quarantine period efficiently. We were able to successfully and effectively transfer the opening and closing ceremonies, jury evaluations, and workshops into the online format. At the same time, all the certificates were sent to the participants as online certificates.

We had a cultural night, which is the most important inclusion event that we enjoy every year. In this new streaming format, we used promotional videos from the 24 participating countries, and showed them at our closing ceremony. Thus, we enabled participants to get to know different countries and cultures. We also made a brief video of all the online events held within the scope of Buca IMSEF. Unfortunately, we could not share face-to-face social and cultural activities with our participants and host them in our country. People living in Buca could not meet with

Buca IMSEF 2020 Closing and Award Ceremony

Buca IMSEF 2020 News in Media

the international participants. Poster presentations and a project exhibition were not possible within the scope of scientific evaluations. Also, icebreaking events could not be transferred to the online format. Still, we tried to make up for the cultural trips we normally organize through promotional videos and presentations. After our fair, we sent a survey to all the participants and received positive replies about Buca IMSEF.

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EXPO-SCIENCES CHILE: DEVELOPING SCIENTIFIC CULTURE

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Abstract. *Expo-Sciences Chile is a Youth Scientific and Technological Popularization Activity of the International Movement for Leisure Activities in Science and Technology MILSET and the Latin American Region MILSET AMLAT, organized and coordinated by Fundación Club Ciencias Chile, with the collaboration of educational institutions. The Expo-Sciences has been developed for 5 years in Santiago de Chile, being its fifth version in virtual format, due to the COVID-19 pandemic.*

The virtual format of Expo-Sciences Chile allows the use of digital platforms, which are selected according to the objectives and activities to be developed. Different on-line platforms were used for the programmed activities, highlighting the synchronous communication tools, with videoconferences and on-line meetings by Meet, Zoom, Microsoft Teams, and Skype. Asynchronous communication tools used e-mail, and WhatsApp. Finally, information was posted on Instagram, Facebook, and YouTube.

Forty-six Chilean projects registered, 34 international projects, with a total of 278 participants from 16 countries, including: Argentina, Brazil, Chile, Colombia, Costa Rica, Guatemala, Ecuador, El Salvador, Mexico, Panama, Paraguay, Peru, Puerto Rico, Russia, Tunisia, Turkey.

Expo-Sciences Chile 2020 was publicly streamed through Facebook and YouTube, achieving an impact of the virtual audience of registered participants and general public of more than 23,201 users, connected within the framework of promotion and transmission on official social networks.

Keywords: *Virtuality, Expo-Sciences, digital platforms, social networks.*

Expo-Sciences Chile is a space for scientific, technological, cultural and social exchange that contributes to the strengthening of formal education and collaborates with the promotion of Youth Scientific and Technological Popularization Activities at national and international level.

The participants of the Expo-Sciences are students and teachers of primary education, secondary education, and university and/or technical education. They are interested in the development and presentation of research projects in the scientific, technological and human areas at regional, national and international level, strengthening the multidisciplinary, integral and inclusive learning of girls, boys and young people.

Expo-Sciences Chile has allowed the participation of more than 300 Chilean projects in the last 5 years, and more than 100 international accreditations to winning projects. It has also conformed the Chilean delegations of more than 500 students that have represented our country each year in the London International Youth Science Forum (LIYSF), GENIUS Olympiad (USA), I-SWEEP (USA), International Research School (RUSSIA), Youth Science and Technology Bowl (Hong Kong), and national and international MILSET Expo-Sciences of each region.

FROM FACE-TO-FACE TO VIRTUALITY

Expo-Sciences Chile in a face-to-face format allows communicative interaction among participants in the same place and time, allowing the development of diverse learning skills and the socioemotional development of children and young people.

Participants are offered a program of activities, and they present their projects in an exhibition stand. There are public visits, lectures, workshops, and visits to museums and science centres. Face-to-face events involve services to participants in terms of lodging, food, and transportation. In this format, there is a logistical development that goes from planning to resource management, including the creation of the event briefing, objectives, participants, location, dates, schedules, execution, and evaluation.

With the arrival of COVID-19 pandemic, the face-to-face format in scientific and technological popularization activities was limited, due to health care and social isolation in each of our countries. A new reality was presented for the development and realization of our Expo-Sciences Chile. A scenario based on Information and Communication Technologies (ICT) allowed the use of Virtual Learning Environments.

Virtual ExpoSciences Chile

FOR THE REALIZATION OF EXPO-SCIENCES CHILE IN THE VIRTUAL FORMAT WE CONSIDERED 6 STAGES OF EXECUTION:

1. Planning. It has to do with the process of organization and evaluation, objectives, and action plan for Expo-Sciences.

It is important to plan national and international participation, with the data and audiovisual materials required from participants. The activities programmed during Expo-Sciences are a joint participation between national and international participants.

It is necessary to determine a program and schedule of activities with the selection of digital platforms, establishing the audiovisual social media that will be part of Expo-Sciences.

2. Invitation. It is the official document with the necessary information to attend the virtual event. The document must contain objectives, dates, and schedules; categories and areas of participation; streaming service, registration process, and participation regulations.

3. On-line Registration. It is done through a Google Form, with personal identification data, institution, and participating project. It is necessary to attach the project paper, project video link, a team photograph, and the video link for a cultural activity.

4. Activities Program. It includes several virtual activities, each of them prepared and planned according to the digital platform.

Live broadcasts were made for the opening, awards ceremony, closing ceremony, and the interviews of the participants with the scientific review committee. Programmed videos were used for the project's exhibition, Chile Virtual Tour, photographic exhibition, and Cultural Day.

5. Participation. There are two formats of participation: students and teachers registered for the event, and guest participants like families, educational communities, authorities, and others.

Virtual participation was organized according to the activities of the Expo-Sciences program with dates and times, and we set 3 hours per day for programming. Video conferences and on-line meetings were streamed in Meet, Zoom, Microsoft Teams, and Skype. Asynchronous communication tools like e-mail, and WhatsApp were very useful. We also posted information on Instagram, Facebook, and YouTube.

Social Network Diffusion

The selection of the digital platforms used for each activity can be seen in Table N°1.

TABLE N°1

DIGITAL PLATFORM	ACTIVITY	VIRTUAL EVENT
Zoom and Meet	Interviews with participants and scientific review committee of Expo-Sciences	Allows visual and auditory interaction between students and evaluators
Facebook and YouTube	Videos of the projects, cultural video of each zone or country, video city tour of Chile, videos and photographs of greetings from each participant team	Allows to store each audiovisual content to visualize and share permanently and repeatedly on social networks
Skype, Zoom, Facebook and YouTube	Presentation of the event, opening, conferences, workshops, awards ceremony and closing ceremony	Allows live chat with the virtual audience; with interaction and recording of the sessions

Participants from Colombia

Participants from Peru

Participants from Chile

Participants from Chile

ASIA PACIFIC CONFERENCE OF YOUNG SCIENTISTS

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Abstract. *A platform for young scientists at the level of secondary school was set to showcase scientific projects in several disciplines of science.*

The Asia Pacific of Young Scientists, or in short APCYS, provides the opportunity for young people with high curiosity to share their research projects in Physics, Mathematics, Computer Science, Environmental Science, and Life Sciences. The students are expected to identify problems around them and propose a solution that is developed scientifically.

It is expected that the learning experience would develop a better way of thinking and nurture future scientists.

Keywords: *young scientist, scientific project, future scientists, APCYS.*

The Asia Pacific Conference of Young Scientists (APCYS) was formatted by faculty members from several universities in Asia. The aim is to provide a platform for the young people at the secondary school level to showcase their scientific work, exchange knowledge based on their projects, and learn from each other as well as from the experts. At the conference, students, teachers, and the experts meet, communicate about their research works, and update issues related to the projects. The fields of the science projects are Physics, Mathematics, Computer Science, Life Sciences, and Environmental Science.

The idea of bringing up young scientists in Asia and the Pacific region to the international level was positively responded by Indonesia, Malaysia, Thailand, Singapore, Taiwan, Japan, Australia, Korea, Nepal, and Guam. It is expanding now to more countries from Asia, Europe, Africa, Australia, and The Americas. Even though the name of the event states the Asia Pacific, the participants are international students from around the globe. The steering committee board is also expanding to more members from host countries.

To keep the standard of the forum, the steering committee board holds a meeting every year, hosted by the next country organizer. Another effort to keep the standard of the competition

is to have country representatives. The representatives of the countries select the best students from their country to participate in the competition. In this way, national and local competitions develop and promote research in their countries. This is the purpose of the Asia Pacific Conference of Young Scientists.

The APCYS focuses on the scientific thinking of young scientists. As a competition, APCYS seeks critical young people with high curiosity who can identify problems around them and propose a scientific solution. Working with analytical thinking is necessary to prove the hypothesis and explain whatever they get as a result. The product itself will no longer be important, since the APCYS is not an inventor nor innovation competition. Logical thinking of students and proper research methodology are more important, which will be highly rated at the evaluation session. The judging criteria include the clarity of the thesis statement and research question, justification of methods, and techniques applied by the presenter to solve the problem, results, and conclusions. The panel of judges is selected from the proposals by the countries' representatives. Faculty members of universities and professional researchers from various research institutes support the judging process under the steering committees' supervision.

There were 6 categories at APCYS before the COVID-19 pandemic hit: research competition, scientific poster contest, cultural performance, teacher sharing session, general lectures, and sports. These elements show the importance of stimulating the right and left brain of the young people in a scientific event. Since 2020, when the event turned to virtuality, the last category, sports, had to be dropped. The first category brings teachers as research supervisors of the students. Many countries do not have research activity in the curriculum, the teachers are not assigned and trained to supervise the students with proper research methodology at school. The APCYS provides a platform for teachers to share their experience in supervising science projects and exchanging their knowledge.

Under normal circumstances, participants gathered in a dormitory, or a hotel designated by the host. The program would run for 5 days. In the virtual conference, there were no face-to-face meetings at all. Everyone followed the virtual activities using digital platforms such as Zoom, Google Meet, and Microsoft Teams. The main challenge was the zone timing, since the participants were from different parts of the world. Another challenge was the Internet connection. After all, the problems were solved with the passion and care of the judges.

The APCYS was held in Indonesia in 2012 (Palangka Raya) and 2013 (Palembang), followed by Taiwan (New Taipei City) in 2014, Malaysia in 2015 (Kuala Lumpur), India in 2016 (Gurgaon), Nepal in 2017 (Kathmandu), Thailand in 2018 (Rayong), Russia in 2019 (Yakutia), and back in Indonesia in 2020 (Bandung). In 2021, the APCYS was held in Mexico and ran virtually again.

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STEAM ONLINE EFFORTS IN THE STATE OF KUWAIT DURING COVID-19.

A TURNING POINT WITH ENDLESS BENEFITS

Abstract. *The MILSET Asia office in the state of Kuwait oversees the organization and coordination of students' activities and meetings. The COVID-19 pandemic forced lockouts everywhere in early 2020, but MILSET Asia has not stopped its activities and switched to the online mode to cope with the "new normal".*

Keywords: *MILSET online efforts, open doors, benefits*

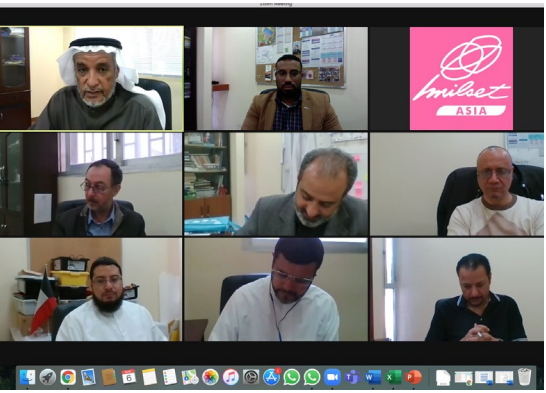
PRE-COVID-19 ERA

Before February 2020, MILSET Asia in the state of Kuwait was running its programmes according to the annual agenda with a variety of activities including workshops, student and teacher training, and competitions in science and technology. In the latter, students defy the challenges in robotics, Arduino, and electronics. In fact, this is MILSET's substantial mission to develop STEAM among the youth.

Preparations were underway for the 2020 editions of Arduino International Day, the Kuwaiti-French Scientific week, and Expo-Sciences Asia 2020 in Dubai. Suddenly, not only MILSET Asia but the rest of the world were forced to accept lockouts, closed borders, and the halt of schools. It was a shock for everyone, but, once again, the challenge was the keyword as the shock was absorbed and the reaction to this exceptional situation was swift.

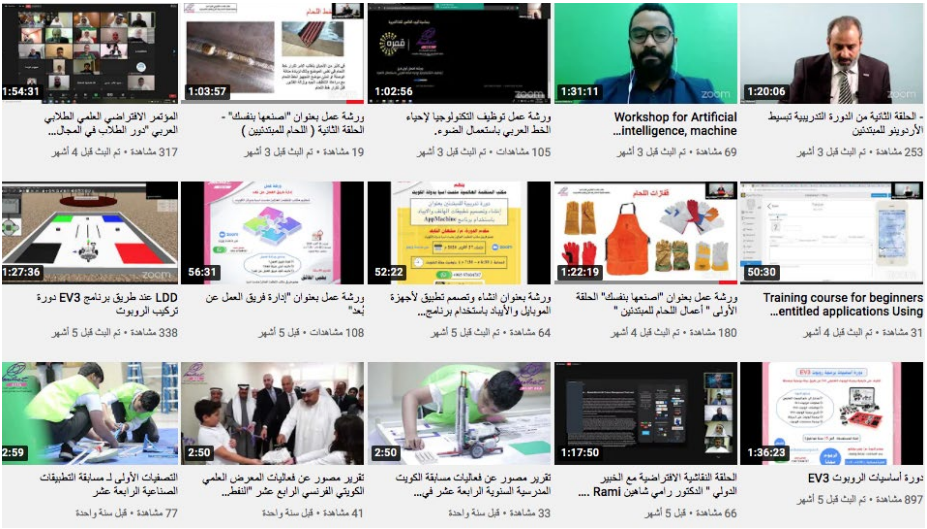
ONLINE MEETINGS AND PLANNING

The "new normal" imposed itself as people could only be in contact online. Therefore, the MILSET Asia office staff felt that the virtuality was the best way to adapt MILSET activities, ensuring that the youth would benefit from them. Zoom, Microsoft Teams and many other platforms have proven to be more than essential to replace the face-to-face events. After some online meetings, the MILSET Asia staff was able to complete its plan for the rest of 2020 and the beginning of 2021. As a result of this, a studio was equipped and opened.



MILSET ASIA ONLINE ACTIVITIES: DIVERSIFICATION AND REACH

After planning and taking into consideration the requirements of the New Normal, the MILSET Asia office moved to the implementation of the virtual activities. The activities were varied and streamed to a wide range of recipients. Workshops were given by some experts and the MILSET Asia staff on EV3 robot, Arduino, and App Machine applications. Mechanics also had its turn with a series of online training sessions called" Do It Yourself", focusing on iron formulation and measuring tools. "How to manage a Team Online " was the title of a training which was given to teachers and team leaders. The MILSET Asia office tried to reach the youth and give them the opportunity to present their innovations during the COVID-19 pandemic. This was the idea of the Arab Youth Scientific Congress in November 2020, where 26 finalists were selected and met online to present and exchange ideas.



INCREASE IN THE NUMBER OF PARTICIPANTS: THE ONLINE MERIT

At first, everybody in MILSET Asia was full of concerns and we feared that we would lose many of our followers and members. We did not imagine how online events could open doors for many people, and, surprisingly, the number of participants in the trainings and workshops doubled, then increased more and more.

In face-to-face activities, there is a limited number of participants set by the requirements of the venue, but virtual events are open to a bigger number of participants. The benefits are endless as those who cannot attend live events can see the episodes later on YouTube or any other available media. This is how COVID-19 pandemic was a turning point with endless benefits.

REMOTE SCIENCE CONTESTS AND EDUCATIONAL EVENTS: LESSONS OF 2020

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Abstract

The past two years completely changed our views on research, education, and virtuality. Various events initially designed to be on-site have been reconsidered and adjusted to be carried out online. High school entrance exams, international chemistry Olympiads, scientific conferences, and summer schools reveal both drawbacks and advantages. Yet, the prevailing result has been positive. There is no doubt that many creative online solutions will be further applied whatever the format of the event will be.

Keywords: *remote subject Olympiad, online research conference, youth science fair*

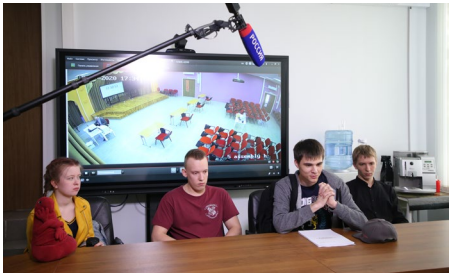
The year 2020 turned out to be unique for the entire humanity because of the COVID-19 pandemic. Still, the influence of this global problem on various countries, fields of activity, events, and individuals was completely different. While some regions and spheres were suffering from the total lockdown, others took the situation as a challenge. Now we can conclude that the pandemic gave a mighty push to online life and activities. Those who promptly understood it, started adapting conventional events to new circumstances. In this contribution, we analyse the best practices, which were developed while organizing domestic and international events.

The entrance exams to the Moscow State University High School (MSU HS) were the first we conducted online. Young people had to successfully pass two rounds of competition, which had been offline before, to be invited to study at this boarding school for gifted students from all over Russia and neighbouring countries.

In 2020, we started studying the solutions available at the market with a strict decision to retain the conventional format of the exams and not to downgrade to online tests. This turned out to be possible only in case of high-level proctoring, which required a learning management system (LMS) with integrated video conferencing. Numerous tests finally allowed designing a reliable protocol based on Canvas (freeware) with integrated Big Blue Button (BBB) videoconferencing. As a result, we understood that online exams require more staff, mostly proctors. Besides, plan B is always needed, since anything may happen to the internet connection at both ends. Nevertheless, the system we developed was approved and widely used to conduct subsequent events.

The 54th International Mendeleev Chemistry Olympiad (IMChO), a competition of about 150 students from nearly 30 countries, was initially planned to be held on-site in Budapest (Hungary). This contest typically includes 3 exams – 2 theoretical ones and 1 experimental one. Once it became clear that the offline Olympiad was not possible in 2020, the Organizing and Science Committees opted to host an online competition. To make it feasible, we had to skip the experimental part and use proctoring, similar to that described above. A parallel channel for international communication (Telegram or WhatsApp) was found to be very useful for the smooth flow of the competition. Finally, 130 students from 20 countries really enjoyed 2 theoretical exams for the first-time-ever on-line IMChO. The event lacked social activities, typical of conventional Olympiads, thus it was decided to bring lectures of prominent scientists, round tables with leading industrial experts, digital entertainment, and a bright Opening Ceremony in case of subsequent remote Olympiads.

The International Chemistry Olympiad (IChO) is a bigger annual contest, typically gathering more than 300 students from about 85 countries. The Olympiad was also conducted on-line for the first time (231 students, 60 countries). Still, the procedure was completely different from that at the IMChO. First, there was no real proctoring. Also, the new role of an invigilator was introduced. The invigilators' major duties were



The Russian team just completed the remote exam at the IChO-2020

to collect students in one location, download, print out and distribute exam papers, collect, scan and upload students' answers, and organize live Zoom video streams. This was especially welcomed since there is no need for plan B in case of invigilators. On the other hand, having the invigilators was definitely a demonstration of high level of trust within the IChO community. Finally, the International Jury, composed of mentors from each country, was provided with a special Oly-Exam software developed for the Jury meetings and translation of tasks. All the novelties proved helpful and most probably will be used in future at both on-site and remote IChOs.

The second round of the MSU HS entering exams, the so-called Summer School, was carried out on-line in July. The participants were offered a vast program including lectures, seminars, works conducted in groups, social events, individual and group talks; everything was possible due to the previously developed system based on Canvas with the integrated BBB. We had practically no drawbacks, despite some obvious difficulties, e.g., many time zones in Russia. Indeed, we found out that in the online format the Summer School was much more demanding.

The All-Russian Kargin Conference on Polymers -2020 was another challenge. The conference was conducted in its typical design with plenary lectures, numerous sections aimed at different topics of polymer chemistry, and hundreds of posters. All the activities were easily transferred into the Canvas/BBB media, and sometimes the online format gave even more options to the conference participants, as compared to the conventional face-to-face event.

At the end of 2020 we held two more Olympiads in Chemistry: the School Teachers Contest of chemistry at Moscow and the 5th Metropolises Olympiad. These competitions were of special interest since we managed to conduct practical exams at both events. To do so, we announced the lists of equipment and reagents in advance. Both lists included more items that were actually needed; still, all the items were readily available for all the participants. Such an approach did not allow the contestants to figure out the chemistry brought to the competition, keeping it a secret until the very day of the exam. Moreover, the participants were asked to take and submit pictures of the synthetic products straight on the balances, which allowed qualitative and quantitative grading of the synthetic work.

Kargin polymer coinference. Poster session

Though we all miss on-site events, the year of 2020 demonstrated that a lot can be done remotely. Online events require creativity, right choice of platforms (LMS, videoconferencing), endless testing, and the existence of plan Bs in many cases. We concluded that vast social and scientific programmes are crucially important for the success of various competitions. It is most probable that in the future internet technologies will be used at on-site events, too.

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MILSET WORLD VIRTUAL YOUNG CITIZENS CONFERENCES 2020

A NEW WAY TO APPROACH A PROGRAMME ON VIRTUAL MODE

Abstract

- *MILSET Young Citizens Conferences aim to provide young people a worldwide opportunity to express themselves through STEAM.*
- *MILSET YCC's goals are achieved through a methodology that leads youth to debate on the social impact of science and technology in the modern world.*
- *MILSET YCC methodology can be adapted into a virtual mode following a detailed strategy.*

Keywords: *STEAM programme, youth, methodology, strategy, virtual, debate, technologies*

MILSET Programmes aim to provide young people worldwide an opportunity to express themselves through Science, Technology, Engineering, Arts and Maths (STEAM). One of the top programmes of MILSET is the Young Citizens Conferences (YCC) which has been organised for more than ten years in a face-to-face mode in different countries.

The objective of the YCC is to hear the opinions, concerns, and proposals of youth regarding the social impact of science and technology on the modern world. Gathering their voices from every part of the globe through creating a space where they can express themselves, engaging them in discussion and debate, enabling them to discover their responsibility, meet peers from other countries and interact.

The year 2020 was a year that taught us how adversity can be an opportunity to reinvent and improve the way we do and communicate things. As the pandemic forced the world to close borders, MILSET had to cancel its face-to-face programmes as many other organisations did. This situation led the MILSET team to reconsider and redesign the MILSET YCC the firm goal to find the best way to create a forum. This tool had the objective to hear and learn what the youth had to say about the new panorama we were facing and the possible solutions for the future.

This challenging journey started with the idea of presenting the "MILSET World Virtual Young Citizens Conferences 2020". Thanks to the leadership of the MILSET Executive Committee and the MILSET YCC Committee, the MILSET Staff established detailed plan to promote the participation of the youth from 13 to 25 years old.

YCC METHODOLOGY

The MILSET YCC goals could only be achieved through a methodology that MILSET once developed and that allows young people worldwide to discuss, debate and present a relevant proposal on a specific topic in an easy, fruitful, and enjoyable way.

The topic is defined every two years. For 2020 and 2021, it was decided to be about the pandemic effects in the world with the name *Inventing a New World on Globalisation, Digital Lifestyle, Role of Science and Medicine, and Environment and Space.*

The methodology is defined in 3 steps:

- Concerns. The participants are introduced into the issue by asking them thought-provoking questions about the topic and their recent related observations and experiences.
- Discussion. In small groups, participants discuss ideas, issues and concerns related to a specific topic. This discussion encourages them to identify possible future benefits and risks for each topic.
- Actions. Participants explore and list possible actions to solve or reduce the concerns they identified.

Developing a methodology was the basis of success to introduce the programme in a completely different way to the public. It helped to establish priorities and reach our goals in an easier and faster way.

CHANGE FROM ON-SITE TO VIRTUAL

The pandemic that the world unexpectedly faced forced many organisations, including MILSET, to move into a virtual model. Virtual mode requirements are very different from on-site ones. Organising an international debate on this format and making an open call implies thinking out of the box and making it as simple and manageable as possible.

The strategy to organise the virtual YCC debate sessions was carefully detailed, considering every task that could engage candidates, reduce timing, and involve participants to achieve the programme's goals successfully.

STRATEGY TO RUN A MILSET YCC IN THE VIRTUAL MODE

1. Set the main goal in a few words.
2. Analise the methodology of the programme
3. Set the target audience and range of ages.
    - Make a list of activities or material that will support the methodology, such as conferences, interviews, and round tables.
    - Make a detailed schedule of the activities you will include.
    - Set how many people will participate in the event. Analyse how many people in the organising team can be involved.
4. Adapt to a virtual model.

Make every event as short as possible. Do not take too much time in each activity.

Set small groups for the debate. Six to seven participants are perfect to handle.

Consider the different time zones in the world to detail the schedule and choose the best time to involve as many participants as possible.

Make it clear and dynamic. The participants and audience need to know what is going to happen in clear words (Table 1).

TABLE 1.- EXAMPLE OF THE MILSET WORLD VIRTUAL YCC PROGRAMME MATCHING THE YCC METHODOLOGY

Methodology	#	Activity	Schedule	People involved
Concerns	4	Conferences by experts about the correspondig topics	10min opening and closing remarks 30 min conference 20 min answer and question section	Presenter Speaker Moderator
Discussion Actions	6	Round Tables	30 min meeting previous the debate 10 min opening , closing remarks and instructions 35 min for discussion 20 min for conlusion	Presenter Participants Moderator

5. Define the selection process.
    - A registration process is essential. Make an open call and select the best participants by asking questions to evaluate their level of interest and knowledge on the related topic through a registration system platform or registration form. Interested and committed participants will make the debate productive and will make significant proposals.
    - Underage students are required to ask for parental consent.
    - To stream live or show participants faces in public, include data protection policies, and ensure that the participants agree to appear in public.
    - When selecting participants, group them by ages to make them feel comfortable to participate.
    - Organise the round tables according to subtopics, if possible. It is easier to discuss specific topics than a general one.
6. Choose the best technology to go virtual.

Nowadays, there are many easy-to-use platforms to meet and stream live. To make it look professional, get support from an IT (Information and Technology) expert and a graphic designer.

The IT expert will also advise on what platform to use to fit your needs. Here are some points to be considered:

- If using a free version, be sure that the functions you need are available.
- Analyse the price based on how many hours you plan to stream.
- If renting, check every detail of the plan. Analyse the streaming hours per day, and the number of pages allowed to stream.
- Check if the computer resources to stream fit the platform's requirements.
- Check that the Internet connection is fast and stable enough to avoid a lousy quality of the streaming or signal loss.
- To stream, do not forget that a Facebook account or a YouTube account is required.

The MILSET Information and Technology Department uses different software to live stream. They are mostly free, such as the following:

- Skype. You will connect with users worldwide.
- NDI technology allows the creation of virtual video interfaces. It extracts the Skype signal (video and audio) and then processes it independently.
- OBS groups the technologies above to carry out the transmission through virtual scenes and graphics.
- Restream is a tool to send the transmission signal to different platforms such as social networks.

7. Promote the event.
    - Start the promotion as soon as possible. Any means is useful such as social media, email, and more.
    - Use attractive branding to increase participation and social media followers.
    - Stream the event or report the results through social media to increase viewers and followers.
8. Communicate.

Communication is crucial to establish a friendly atmosphere during the debate and to avoid time loss. Keep participants interested and make them enjoy the activity:

- Meet them before the event and let them know they are part of a team. Explain the activity rules and the programme through private chats to make participants self-confident while debating.

- Stay in touch before the debate. Send all the information related to the topic they will debate.
- Inform about all the activities and send them reminders.
- Confirm the participation of each one.
- Be clear on the time zone they will participate in.
- Motivate participants from each debate table after the event to continue doing networking through the chats.

9. Be ready for debate.
   - Find a moderator that could guide participants through debate and, if possible, someone who is an expert on the subject.
   - Prepare a set of general questions before the debate and share them with the participants.
   - Prepare an online form and request the participants to fill it with their opinions, proposals, and conclusions after the debate session.

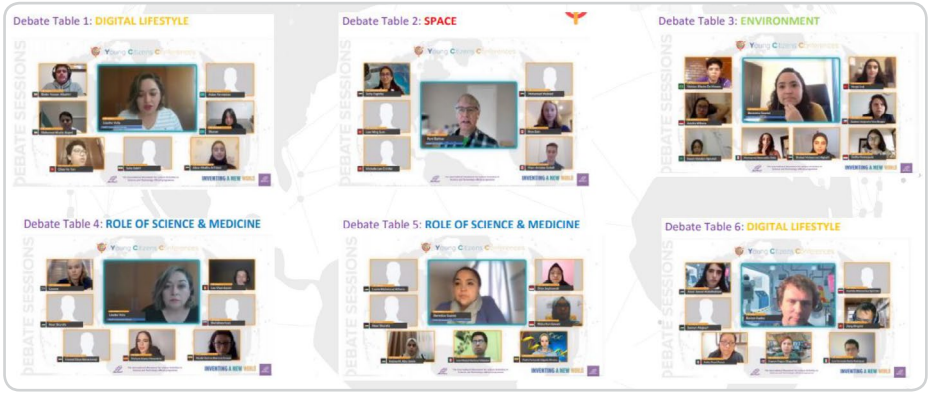
FACE-TO-FACE VS. VIRTUAL

Humans are social beings who need to be near each other to effectively communicate through words and body language, emotions, and touch. Those who had to change face-to-face events to virtual events know that the experience will never be replaced.

MILSET used to run YCC on-site, which allowed participants to interact face-to-face, strengthen bonds, make friends, take enough time to discuss, work together, and present their conclusions to the public. The surprising thing is that participants find a way to follow the same structure in the virtual mode, adapting their communication to the new requirements like fast interaction, more guided and structured participation, and the use of virtual communication platforms.

Virtuality also has notable advantages: it is possible to reach more people from different parts of the world, the public can easily connect and see the event through different platforms, more people can learn about the organisation and programmes, costs may reduce and so events turn more accessible for the public, and it is an opportunity to increase your social media viewers.

MILSET's aim is to encourage youth participation through MILSET members, organisations, institutions, and schools worldwide. The information on how to organise a MILSET YCC is available on www.ycc.milset.org.



MILSET World Virtual YCC debate sessions

RIPPLES IN SPACE

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Abstract

Since 2015 the Laser Interferometer Gravitational-Wave Observatory (LIGO) has been proving Einstein's theory of general relativity. By detecting gravitational waves LIGO has given us a whole new window through which we can observe the universe. This article introduces the field of gravitational waves and how we measure them.

Keywords: *LIGO, gravitational waves, general relativity*

LIGO Hanford is, in principle, just a Michelson interferometer. However, if you go for a run along one of the arms, you get a sense of the scale of the experiment. You start at a low insignificant building in the middle of nowhere, with two concrete tunnels extending at 90 degrees from each other. You follow one of the arms on a straight paved road. In the distance you can see a white building connected to the concrete tunnel. On one side you have the tunnel, on the other you have a clear view towards the horizon of the desolate area you are in. Nothing but tumbleweed and low vegetation. After 2 km of running, you reach the white building. It has no features other than a door. Going around it, you realize the tunnel continues through another white building. Determined to reach the end you tread on and eventually get to the end.

What is a Michelson interferometer? Imagine shining a laser onto a piece of glass, a beam splitter, which splits the light in two directions perpendicular to each other. The light travels some distance, it is reflected by a mirror, and eventually makes its way back to the beam splitter, where it recombines and hits a screen. This is what a Michelson interferometer is. In the case of the two LIGO detectors in Hanford and Livingston, their interferometer arms are 4 km each.

The interferometer's name comes from the fact that the recombined light interferes producing an interference pattern on the screen. If the light has travelled the same distance along the two arms, the light constructively interferes, but if there is a distance of half a wavelength, they destructively interfere (a distance of a full number of wavelengths again means constructive interference).

The original Michelson interferometer was built to detect the aether, a hypothesized invisible liquid filling all of the universe which was introduced for light to have a medium to move through. This hypothesis was famously disproven with Einstein's theory of special relativity. Today the experiment is used to prove his theory of general relativity.

According to general relativity, gravity is not really a force but rather a curvature of the space-time continuum. A sentence such as the previous is one of those that sounds incredibly profound and smart, but really tells us nothing if we don't know what it means. Let me try in a different way.

If you want to take the shortest path between two points, you know it is a straight line. If you try to draw this on a piece of checkered paper and you want to move five squares to the right and five squares up, you draw the diagonal. If the squares were changed in size so that they were twice as wide and tall, nothing in your method would change. What if the squares didn't have the same size? If some squares were squeezed and others stretched, it would be more difficult to see the straight line. We know of this effect from maps, where depending on which method you use the size or shape of different continents will change.

Now, if you imagine the piece of paper to represent space, you should probably replace the paper with a more flexible material like latex. Mass is now something that stretches your piece of latex and how much it does is what we call gravity. Where it gets really weird is that your piece of latex represents not just space in two dimensions but time too, the third dimension.

When physicists say that gravity is the curvature of the space-time continuum, what they really mean is that space is wobbly and heavy things make it wobble. However, it is not that wobbly, otherwise the world would be quite a weird place to be. In fact, space is less wobbly than any (real) material you have ever heard of.

The term "heavy things" is a bit of an understatement. You may find a ship in the Suez Canal heavy, but gravity is not. The Earth isn't heavy enough either to have that much of an interesting effect. It's sure the gravity keeps us all bound to the ground and the moon in orbit, but in the great scheme of things it's really not that heavy. The sun is getting closer to something of a reasonable mass, but for the effect we are interested in we either need something which moves a lot faster or is a lot heavier. In fact, regular stars aren't heavy enough in general. Instead, we need something like a neutron star or a black hole, and not just one, we need two.

Imagine you have two of these heavy objects and they are close together. They will then tend to start rotating around each other getting closer and closer and moving faster and faster until they merge together in the end. This doesn't sound all that extreme but remember that the two objects have a mass of more than ten times the mass of the sun, are moving at speeds close to the speed of light, and when they merge the collision is so great the average power output is greater than the combination of light from all stars in the visible universe. Until the first time we measured the merging of two neutron stars, we had no idea where most of gold and other heavy elements in the world came from. Now we do. It comes from these kinds of mergers. One merger of two neutron stars can produce gold in the amounts of Earth-sized lumps (unfortunately it probably ends up in lots of smaller lumps).

It's time we get back to our regular Earth with only small amounts of gold and discuss how we can actually measure these kinds of mergers. This is where LIGO Hanford appears in the picture. When the two heavy objects were rotating, they were changing the shape of space around them by quite a lot because they were so heavy and moving so fast. These changes spread out like ripples in water and eventually ended up here on earth. When they reached the arms of the observatory, the length of one arm would shortly be longer than the other,

Looking along the arm of LIGO you can barely see the midway station

then shorter, and then longer again. For as long as it took the two heavy objects two rotate and merge, the oscillations in length of the arms will continue to grow in size and then suddenly die out when the two objects merged. The same thing will happen at the other LIGO in Livingston, at VIRGO in Italy, and in the future at KAGRA in Japan and IndIGO in India.

An experiment like this is extremely sensitive. LIGO is able to measure changes in distance on the scale of a 10.000th the width of a proton. If you go on the aforementioned run, they won't be able to run the experiment. If the wind blows too heavily or a truck drives by too closely, they will be able to see it.

Discovering gravitational waves, the ripples in space, was such a huge achievement that it was awarded the Nobel Prize in physics just two years after. The search for gravitational waves continues today. It has opened up a completely new window for observing space. Now we don't need light to see.

If you want to learn more about gravitational waves, there are plenty of resources on the internet. Some videos I would recommend are those on YouTube by Physics Girl, Veritasium, and PHD Comics. If you are interested in teaching about gravitational waves, Perimeter Institute has some great material available for free download called Discovering Gravitational Waves. Finally, LIGO Hanford offers a great program for educators over the summer called the International Physics & Astronomy Educator Program, where you spend a week learning about gravitational waves and methods for teaching physics and astronomy with likeminded educators from all over the world.

The arm separates the area in two halves. On one side you see the tumbleweed pile up

THERMOELECTRIC POWER GENERATION FOR GREEN ENERGY

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Abstract

Thermoelectric power generation is deemed as a means for saving energy, thus reducing hazardous pollution, and softening the environmental problems. This minireview surveys the history and current state of the development of materials converting waste heat into electrical power, paying primary attention to contemporary and emerging materials and approaches, and to perspectives of applications in the nearest future. Thermoelectric potential of long-period chalcogenide semiconductors, disorder low-gap semiconductors, phonon glass-electron crystal compounds, and synthetic copper-chalcogenide minerals are particularly discussed.

Keywords: *alternative energy sources, thermoelectric materials, power generation.*

INTRODUCTION

The future of our planet largely depends on the ability of the mankind to eliminate dirty sources of energy. Globally, coal, oil, and natural gas give more than three quarters of the required energy, but in return we receive unavoidable contamination by many types of unhealthy chemicals that accumulate around us. Besides widely criticized but less hazardous carbon dioxide, poisonous chemicals such as nitic dioxide, sulphur dioxide, dioxins, and many others pollute the environment. It is now commonly accepted that fast transition to carbon-free energy sources is the only way to preserve our planet for future generations. However, this process requires the development of reliable and non-expensive sources of clean energy, which do not come in one short moment as wonderous apparition.

Today we are witnessing the wide introduction of solar and wind energy, especially in post-industrial countries; electric cars are coming to the streets, and hydrogen is about to appear as another clean energy source. Very soon coal and oil will be transformed into the source of chemicals, polymers, pharmaceuticals, fertilizers, and other important products of our civilization, ending their career in energy production, whereas the relatively cleaner natural gas will persist longer as the energy means.

One of the obstacles in all-round implementation of environmentally-friendly energy sources is their high cost. On one hand, this stimulates developed countries sponsoring the use of the clean energy such as solar, tidal, or wind. On the other hand, various technologies have been introduced that help saving energy by its recovery. Among those means is the use of thermoelectric materials to generate power from waste heat. With the growing production of various kinds of engines, the need in thermoelectric convertors will increase; therefore, our goal is to provide cost-effective and environmentally-friendly thermoelectric materials for the everyday use.

BACKGROUND AND HISTORY

Thermoelectric materials can play different roles depending on the mode of their use. They can generate active heat upon application of the potential difference, or generate electric power upon application of the temperature gradient. Those stem from two fundamental effects discovered in the first half of the 19th century. The Seebeck effect relates the electromotive force that develops across two junctions of two conductors of a different nature in response to a temperature difference in them. The coefficient of proportionality between the electromotive force and temperature difference is known as the Seebeck coefficient. The Peltier effect is the reverse effect, it describes the temperature difference as a response to the applied voltage.

Figure 1 shows the schematic presentation of these effects implemented into thermoelectric devices. The left panel shows that the electric current flowing by the definition from the positive pole to the negative one passes through the n-type conductor attracting electrons and then through the p-type conductor carrying holes along. Therefore, both types of charge

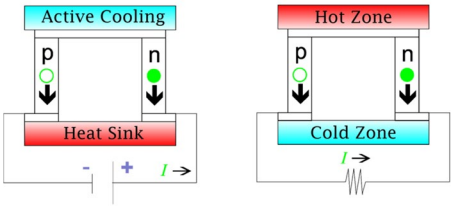

Figure 1. Schemes of thermoelectric cooling (left) and power generation (right)

carriers travel in the same direction moving heat from the active side to the heat sink, thus producing cold at the former. The right panel sketches the process of power generation upon applying the temperature gradient to a couple of conductors. Whereas a couple of conductors is enough to observe the desired effect, for practical applications such couples are assembled into batteries, electrically in series but thermally in parallel.

The efficiency of a thermoelectric material is expressed by a dimensionless figure-of-merit, $ZT = S^2T\sigma/\kappa$, which is dependent on the Seebeck coefficient S, absolute temperature T, electrical conductivity σ, and thermal conductivity κ. Clearly, to achieve better efficiency, a thermoelectric material should possess low thermal conductivity to prevent the heat from coming back to the equilibrium. Also, it should possess high electrical conductivity to ensure the effective transport of charge carriers, but at the same time it should not be a metal, for which bipolar conductivity leads to very low values of the Seebeck coefficient. Such conditions have led to low-gap or degenerate semiconductors as potential thermoelectric materials.

According to the potential application, all thermoelectric materials are classified into two groups, power generators and Peltier coolers. Up to this day, roughly 95% of the thermoelectric global market is occupied by Peltier coolers, which are fabricated from properly doped bismuth telluride Bi_2Te_3. This material was introduced by Ioffe in 1950 and since then no better material was found to replace bismuth telluride in the industry. Today, for ***n***-branches Bi_2Te_3 is doped with selenium, whereas doping with antimony affords ***p***-branches, which gives the appreciable ZT of 0.96–0.98 in the range of 30–90 °C. When it comes to thermoelectric power generation, the situation is different. At low temperatures, the same Bi_2Te_3-based materials are exploited. The use of doped bismuth telluride is limited by approximately 150 °C when the ZT starts to decrease rapidly with temperature.

Today, the role of bismuth telluride in power generation is declining. Only niche applications have remained. One of them is the power generation at low temperatures for remote control stations in deserted places, also known as SCADA (Supervisory Control and Data Acquisition), where the electric grid is not available. This is particularly important for controlling pipelines in far North of Russia and Canada. Another application that was developed through the 1960^s and 1970^s but is rarely used today is the power generation for unmanned spacecrafts, where plutonium dioxide served as the heat source. Evidently, such kind of power generation leaves radioactive waste in the circumterrestrial space, raising ecological questions.

In the 21st century, one should take into account that tellurium is the 7th least abundant element on Earth, its supply is at risk. Furthermore, the industry of recovering tellurium by recycling it literally does not exist. As a result, the price for tellurium is swinging, prompting the search for and development of alternative thermoelectric materials for power generation.

WHAT ARE WE AFTER AND WHY?

Whereas thermoelectric coolers work in a narrow temperature window of 0–150 °C, thermoelectric generators are deemed for a much wider range (Figure 2).

Today, thermoelectric power generators are required in two high-potent industries. They are the automotive industry and the solar energy harvesting. The former offers powerful cars and trucks,

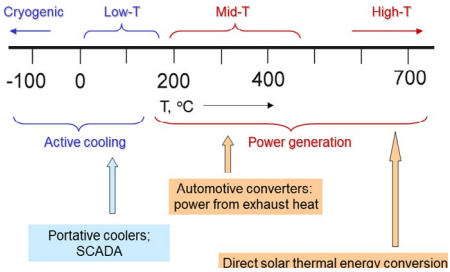

Figure 2. Thermoelectric applications on a temperature scale

no matter what kind of engine they have. Working on combustion engines or using electrical or hydrogen powered engines, automobiles lose nearly two thirds of the produced power because of thermal radiation, idle working, and breaking. A good portion of that lost energy can be recuperated by thermoelectric generators and returned into the power system of a car. When the Carnot efficiency of a thermoelectric generator is low, about 7%, such devices are installed only on heavy trucks and powerful cars, where the radiated heat provides enough energy to approve the use of low-efficient thermoelectric generators. However, when more expensive electric and hydrogen engines replace those working on gasoline and diesel oil, the advantage of using thermoelectric generators will grow, ultimately leading to the soon coming universal use of thermoelectric generators working between 200 and 500 °C.

We expect the new generation of automobiles, i.e., those that do not exploit combustion engines and emit carbon dioxide and other toxic pollutants will be substantially cleaner and environmentally benign; therefore, there is a demand for nontoxic and inexpensive thermoelectric materials for the automotive industry. For this, we have to exclude lead telluride, which is known as the only thermoelectric material for a mid-temperature power generation fabricated by the industry. Furthermore, we should discard potential materials containing gold and platinum metals, heavy rare-earth metals, radioactive elements, and such toxic metals and metalloids like cobalt, arsenic, or thallium, albeit their derivatives show good promises for high ZT.

Another important area for thermoelectric power generators is the industry of converting solar energy into electricity. Basically, there are two technologies for extracting power from solar radiation. The first one is based on the photovoltaic effect, where the visible sunlight is converted into electricity by means of semiconductors. A photovoltaic system is based on solar cells that operate at temperatures near 100 °C. At the same time, the remaining part of the solar radiation, namely, its infra-red part, also known as solar heat, can be used to produce electricity through the thermoelectric conversion. For this, the following requirements should be addressed to a material. First of all, it should be thermally and chemically stable at working temperatures of 600–900 °C. Secondly, it must comprise only environmentally-friendly chemicals. Finally, it should demonstrate reasonably high ZT approaching unity at working temperatures.

Up to now, no commercial thermoelectric materials for solar heat conversion are available. Most of the research is focused on developing the so-called dual systems, in which the entire solar spectrum is passed through the concentrating lens and wavelength separator, after which the visible part of the spectrum produces electricity employing the photovoltaic effect, whereas the infra-red part is converted by thermoelectric materials.

THE TRENDS

A search for new thermoelectric materials that are not associated with bismuth and lead tellurides started more than three decades ago. Looking back at Ioffe's ideas, one may recognize that his prescriptions indicate that the best thermoelectric material should be searched in the family of low-gap semiconductors composed of heavy elements. Being properly doped, such compounds demonstrate efficient transport of charge carriers, holes or electrons, and sufficiently low thermal conductivity stemming from high atomic masses. Together, these properties lead to appreciably high thermoelectric figure-of-merit. Not surprisingly, the search for better thermoelectric materials started with scrutinizing a variety of low-gap semiconductors composed of heavy elements, and very soon potential candidates came to the forefront. Albeit having intriguing thermoelectric properties, they all provided little help to the industry because of including such elements as expensive gold or very toxic thallium.

As a development of Ioffe's ideas, the investigation of the so-called long-period semiconductors that possess the crystal structures came. This can be viewed as the expansion of the layered crystal structure of bismuth telluride along the ***c***-axis of the hexagonal unit cell. For this, an alternation of different structure blocks could be employed, ultimately leading to the structures with the ***c*** unit cell parameter exceeding 10 nm (Figure 3). Again, prospective thermoelectric properties have been found, especially in the Ge-Bi-Te and Sn-Bi-Te systems, but all the potential candidate materials contained expensive yet slightly toxic tellurium.

Attempts to modify the approach of long-period compounds have turned into unexpected complex cobalt oxides. They demonstrate an intricate type of layers stacking, such that a layer containing cobalt and oxygen of the general composition CoO_2^- alternate stacks with a positively charged layer composed of oxide, electropositive metal (for instance, calcium), and sometimes additional cobalt (Figure 4). The layers have two different functions, the former is responsible for efficient transport of charge carriers, whereas the latter serves as a charge reservoir. Assembled together, the layers also provide all necessary conditions for rejecting heat carrying phonons. These properties are supplemented by electron correlations and Co^{3+}/Co^{4+} valent fluctuations, enhancing the Seebeck coefficient. As a result, certain representatives of complex layered cobalt

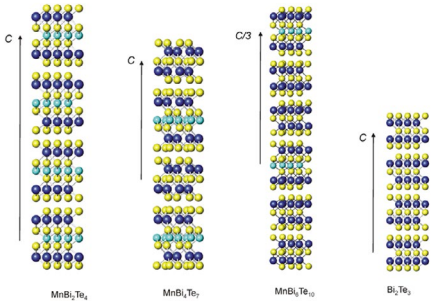

Figure 3. Crystal structure of long-period Mn-Bi tellurides in comparison with Bi_2Te_3. Bismuth, blue; manganese, cyan; tellurium, yellow. Reprinted with permission from Journal of Alloys and Compounds 2019, v. 789, p. 443. Copyright 2019 Elsevier.

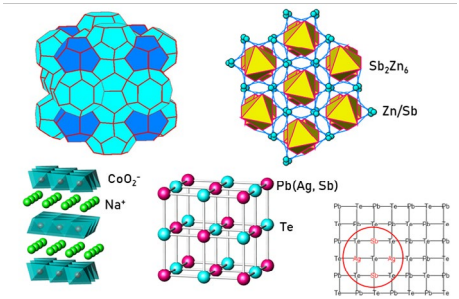

Figure 4. (top left) Crystal structure of type-I clathrate presented as conjugate polyhedra; (top right) crystal structure of $Zn_{4.3}Sb_3$; (bottom left) crystal strcture of $Na_{0.5}CoO_2$; (bottom center) view of the crystal structure of Ag/Sb-substituted PbTe (left) and clusterization of doping atoms (right)

oxides demonstrate high ZT approaching 1.1 at 950 K, $Bi_2Sr_2Co_2O_{8+x}$, holding a record. Another advantage of these oxides is their stability in air towards oxidative degradation at high temperatures.

Further search for better thermoelectric materials did not concentrate on any particular class of compounds; rather, the search was linked to a particular underlying physical idea on how to achieve a combination of efficient transport of charge carriers and poor transport of heat in a given compound. As a rule, these properties are at odds, and in most cases a good electric conductor also demonstrates good thermal conductivity.

The problem of the coupling of the electrical and thermal conductivity has led to the conjecture that these two properties can be uncoupled provided that the crystal structure of a compound is subdivided into two weakly bound substructures, each of which will be responsible of one type of transport, carrying charge or heat. Two families of compounds have been identified and thoroughly investigated. The first of them is the family of inorganic clathrates (Figure 4). Those are compounds having a host-guest structure. The host substructure is a sp^3-connected framework made of post-transition elements, which ensures the efficient transport of charge carriers. The guests are atoms of alkali or alkali-earth metals that "rattle" inside the oversized polyhedral cages of a framework; such pseudo-localized vibrations reject heat-carrying phonons but do not impede the electric conductivity. This approach has been known as "phonon glass – electron crystal" since its introduction by Slack in the middle of the 1990s. Since then, a vast family of clathrate compounds have been tested and many of them are found to be potential thermoelectric materials. For instance, doping $Ba_8Ga_{16}Ge_{30}$ with antimony leads to a p-type material with ZT = 1.00, whereas an n-type material showing ZT = 1.45 can be prepared by introducing copper. These figures of merit are demonstrated near 500 K, which makes this pair of clathrate compounds strong candidate thermoelectric materials for power generation.

Disordered low-gap semiconductors are another class of intensively studied materials. Not all kinds of these semiconductors may lead to efficient thermoelectric properties; literally speaking, too much disorder might be advantageous for lowering thermal conductivity but is detrimental to charge carrier transport. Therefore, locally confined disorder plays a key role as it reduces thermal conductivity but does not impede transport of charge carriers. This is exemplified by $Zn_{4-x}Sb_3$, where Zn_2Sb_6 pseudo-octahedral units form a framework linked by a number of additional atomic positions of zinc and antimony, each of which is scarcely populated (Figure 4). Another example of this approach is provided by the so-called LAST family (L = lead, A = antimony, S = silver, and T = tellurium). In these compounds of a variable composition, Ag^+ and Sb^{3+} substitute for a pair of Pb^{2+} cations in a way that silver and antimony form clusters, evoking local distortion of the crystal structure that serve as phonon-scattering centres (Figure 4). Although high ZT values exceeding 1.5 were reported for representative compounds, tellurium in their composition lowered chances for their industrial applications.

Nanoscaling of thermoelectric materials has long been deemed as a powerful tool for enhancing the ZT. Indeed, at the nanometre level, two effects allow achieving better thermoelectric efficiency. Firstly, the essentially increased surface-to-volume ratio produces a greater

number of intergrain contacts rejecting heat that carries phonons. Secondly, quantum confinement effect increases Seebeck coefficient in expense of electrical conductivity; however, as the former is squared in the ZT equation, the total gain in thermoelectric efficiency is highly expected. However, nanoscaling has been exploited only in the case of thermoelectric materials exploited at temperatures below 100 °C. The higher the temperature, the faster is the aggregation of nanoparticles due to diffusion that accelerates with increasing temperature. As a result, the durability of nanoparticulate thermoelectric materials at high temperature is significantly low, hindering their practical use.

MIMICKING MOTHER NATURE

Surprisingly, Mother Nature has already provided us with thermoelectric materials. It took us more than 50 years to recognize that certain minerals display intriguing thermoelectric properties. It was only in the last decade of the 20th century that, following Slack's "phonon glass – electron crystal" concept, artificial analogs of skutterudite received rapt attention. Skutterudite itself is a mineral with a common formula $CoAs_3$. Its crystal structure is very symmetric and presents a tracery Co/As framework with large voids (Figure 5).

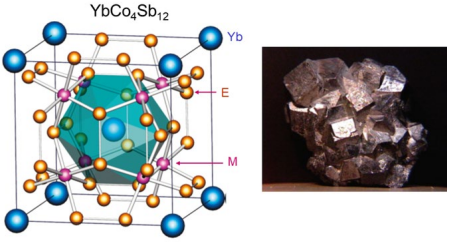

Figure 5. Crystal structure of filled skutterudite (left), note the large polyhedral occupied by Yb, and a picture of a mineral (right)

Laboratory research has shown that upon filling these voids with atoms of large electropositive elements high ZT could be achieved. The reason is the combination of properties related to the crystal structure and properties of the composing elements. Following the Slack's concept, rattling of the heavy atoms in the voids lead to low thermal conductivity, whereas a combination of cobalt and arsenic in the framework augmented by the Co^{2+}/Co^{3+} interplay produces high values of Seebeck coefficient and electrical conductivity. Together, they ensure an appreciably high thermoelectric figure of merit, reaching ZT = 1.3 at 900 K for $Ba_{0.3}Co_4Sb_{12}$. Because cobalt is toxic and its use in the automotive industry is undesirable, this kind of material remains only as a proof that natural products – minerals – are of great importance in thermoelectric research.

Tin selenide SnSe is rarely found as a minor admixture to a mineral known as Herzenbergite, which is tin sulphide SnS. These compounds possess crystal structures very similar to that of black phosphorus but with an ordered alternation of tin and chalcogen atoms. Unlike the sulphur congener, SnSe demonstrates the highest ever measured thermoelectric figure of merit peaking at ZT = 2.6 at 920 K. However, such a high value can be observed only on an oriented single crystal along the ***c***-axis of the orthorhombic unit cell because the crystal structure of SnSe is extremely anisotropic. Although the efficiency decreases when a polycrystalline sample is examined, tin selenide has arisen great interest not only of researchers but also manufacturers.

The largest group of minerals with promising thermoelectric properties is provided by manifold copper sulphides. Copper is present in nature in hundreds of minerals, more than half of which are

various sulphides, from binary to quite complex. Cu_2S and $Cu_{2-x}S$ are known as chalcocite and djurleite, respectively. At high temperatures, above ca. 600 K, they crystallise in a cubic form characterized by fast mobility of copper atoms traveling between several positions of the unit cell, in which sulphur atoms form a fixed framework. This kind of disorder, also known as "phonon liquid", favours a combination of high electrical conductivity and very low thermal conductivity. Near 1000 K, the figure of merit reaches ZT = 1.65 for the composition $Cu_{1.97}S$; however, upon cooling to 600, the phase transition from the cubic to monoclinic unit cell leads to a dramatic change in the unit volume inducing mechanical damage of a material.

Complex copper sulphides do not exhibit problems with phase transitions and thus provide an excellent playground for creating efficient thermoelectric materials. The most interesting example is provided by tetrahedrites, which are minerals containing copper, antimony, and sulphur with an idealized formula $Cu_{12}Sb_4S_{13}$. They have a body-centred cubic crystal structure with 58 atoms in the unit cell (Figure 6). Chemical formula and coordination polyhedra of atoms tell us that antimony is present as Sb^{3+}, whereas out of 12 copper atoms 10 should be Cu^{+} and the other two are Cu^{2+}. In fact, an exact compound with this formula is not present on Earth. Tetrahedrites always contain a number of elements partially substituting for copper and sometimes for antimony. The incomplete list of substituting metals comprises nickel, cobalt, iron, manganese, cadmium, mercury, silver, and lead. Artificial (synthetic) tetrahedrites have chemical formulas written as $Cu_{12-x}T_xSb_4S_{13-y}$, where T is a substituting metal, x is less or equal to 2, and y is very close to zero. The substituting atom plays a very important role in achieving high ZT. It ensures electron transfer between all metal atoms, which becomes in a special type of electrical conductivity known as variable range hoping. If T = Mn or Fe, an additional factor facilitates charge carrier transport, which is M^{2+}/M^{3+} valence fluctuation. Indeed, Mn-substituted tetrahedrites display the highest known-to-the date figure of merit, ZT = 1.2 at 575 K.

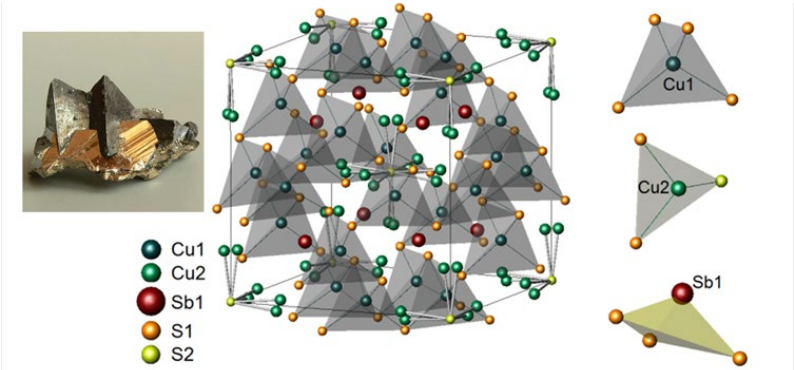

Figure 6. Crystal structure synthetic tetrahedrite $Cu_{12}Sb_4S_{13}$ showing the unit cell (center) and coordination of Cu and Sb (right); a photo of a mineral is shown in top left inset. Adapted with permission from Chemistry of Materials 2016, v. 28, p. 6612. Copyright 2016 American Chemical Society

Moreover, many other synthetic tetrahedrites outplay doped bismuth telluride in terms of achieving higher ZT (Table 1).

Table 1. Examples of ZT for synthetic tetrahedrites. The values outplaying those for commercial Bi_2Te_3 based materials are marked in red.

Composition	ZT(max)	T_{ZT} / K
$Cu_{12}Sb_4S_{13-\delta}$	0.56	675
$Cu_{11}ZnSb_4S_{13}$	1.0	720
$Cu_{11}NiSb_4S_{13}$	0.7	665
$Cu_{10.4}Ni_{1.6}Sb_4S_{13}$	0.8	700
$Cu_{11.5}Co_{0.5}Sb_4S_{13}$	0.99	673
$Cu_{11.5}Fe_{0.5}Sb_4S_{13}$	0.80	720
$Cu_{11.6}Fe_{0.4}Sb_4S_{13}$	0.80	700
$Cu_{11.2}Fe_{0.8}Sb_4S_{13}$	0.83	673
$Cu_{11}MnSb_4S_{13}$	1.13	575
$Cu_{11.25}Mn_{0.75}Sb_4S_{13}$	1.2	575
$Cu_{10.5}NiZn_{0.5}Sb_4S_{13}$	1.03	723
$Cu_{10}Sb_3TeS_{13}$	0.92	720

Synthetic analogs of many other copper sulphide minerals have shown excellent thermoelectric properties. The ZT approaching unity has been documented for artificial analogs of colusite, bornite, kesterite, putzite, stannite, and several other minerals. Interestingly, they all have different crystal structures. Whereas colusite is rather similar to tetrahedrite, kesterite and stannite are derivatives of chalcopyrite, which is a prospective thermoelectric material itself, whereas bornite has its own crystal structure incomparable with other copper sulphide minerals. Despite a variety of crystal structures and properties, the common feature of these compounds is the absence of toxic and expensive elements.

Mother Nature might have created many more minerals with promising thermoelectric materials, and the only thing we need to do is to pick them up. If it were that easy, we would have already created environmentally-friendly and inexpensive thermoelectric generators. However, the secrets are still kept under tight curtains, and it might be a long way for us to uncover the best composition.

OUTLOOK

We are still in need of better thermoelectric materials that will show efficient and stable performance in the temperature range of 200–800 °C. What makes us feel optimistic?

Clearly, today we witness the advances in the development of thermoelectric materials with high ZT, good thermal and chemical stability, made of inexpensive and non-toxic elements, and durable. The best laboratory materials have already overpassed the limit of ZT = 0.96–0.98, which is a benchmark set by properly doped bismuth telluride, and their efficiency grows promising to soon reach the next psychological mark of ZT = 2. Upon achieving this figure of merit, we will see the rapid growth of the thermoelectric generators market. Thermoelectric power generation will become part of our everyday life. Cheap and clean thermoelectric generators will be used in energy production and conversion in industry (automotive would be first), and also in households as simple and as reliable as converters of excessive heat into electric power. Having no moving parts, being easy-to-install, silent, and durable, they will pave their ways to our kitchens, living rooms, bathrooms, and parking places to reduce electricity consumption from the grid.

Although the research into thermoelectric materials for green power generation is an ongoing exploration, it is time when initial vague prospects are turning into solid confidence that not only materials, but also thermoelectric generation devices are our nearest future.

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THE 9TH MILSET EXPO-SCIENCES INTERNATIONAL (MOSCOW, 2003)

Abstract

This article is a collection of testimonies from the key organizers and participants at the largest Expo-Sciences International in the history of MILSET, which was held in Moscow (Russia) in 2003. In the appendix to the article, it is the official Report of the MILSET ESI 2003 and the Address of Youth to Heads of States and governments of the world that was prepared as a resolution of the Congress "The young people hold the future of the planet in their hands", organized in the framework of the MILSET ESI 2003.

Keywords: *MILSET Expo-Sciences International, MILSET ESI 2003, MILSET ESI in Moscow, MILSET impact, history of MILSET*

Jean-Claude Guiraudon

TESTIMONIALS OF J-C. GUIRAUDON ON THE 9TH ESI ORGANIZED BY MILSET SINCE 1987

More than 17 years have passed since Expo-Sciences International 2003, the biggest and one of the brightest ESI in the history of MILSET. Since then, the young participants have matured into adults, the organizers have grown older, but the memories are still fresh in our minds.

In this article we have collected the stories of some of the organizers and the participants of the ESI 2003. They relay great moments, extraordinary atmosphere, and smaller interesting episodes. They also prove that Expo-Sciences is a brilliant invention of MILSET, which must live on and develop for the sake of the youth and the sciences themselves.

We would like to thank Jean-Claude Guiraudon and Tatyana Shmatkova for the idea of this article, as well as for the detailed reconstruction of those events and collected photos and official materials. We also would like to thank all participants and organizers of MILSET ESI 2003 who shared their memories with us.

The originality of the MILSET ESI 2003 in Moscow lies in the fact that it was a part of a large program of cooperation between MILSET and Moscow institutions.

This collaboration goes back to the MILSET ESI 1989 in Brest, the Komsomol[1] delegation was welcomed, and it was made of members of Youth Science and Technology Creativity Clubs (NTTM clubs), headed by Igor Volk, a Soviet cosmonaut and pilot. It was then that the first contact of MILSET with Russia was established.

Few years later, when the Moscow authorities came up with the idea of organizing a large Science Museum at the Central Pavilion of the All-Russian Exhibition Center (VVC), the director of the VVC Central Pavilion, Mr. Vyacheslav Makhotkin, together with Ms. Tatiana Shmatkova, responsible for international relations, decided to receive the delegation of MILSET in Moscow.

In July 1998 the Moscow Government, with active participation of the Head of the Committee for Youth Affairs Mrs.

[1] *Young Communist League*

V. Makhotkin and J-C. Guiraudon, 1998

Irina Mouravieva, organized the World Youth Festival in Moscow. MILSET helped to organize the participation of 8 countries in this event. There were different kinds of activities at the Festival such as sports games at the Luzhniki Stadium. The MILSET team took charge of the Sciences, Techniques, Arts, and Industries, located at the VVC It was also a part of the partnership program of the exhibition centre Parc des expositions de Paris with VVC.

The Candidature of Moscow as a venue for MILSET Expo-Sciences 2003 was submitted during the MILSET ESI 1999 in Puebla, Mexico, and accepted by the MILSET Executive Committee during the MILSET ESI 2001 in Grenoble, France.

Moscow also submitted its candidacy for the Universal Exhibition 2010, and ESI 2003 was formally viewed as an addition to this candidacy. It allowed us to establish excellent relations with the International Exhibition Bureau in Paris, and to be presented at the various events promoting the candidacy. I do not regret our efforts in this direction, even though it was Shanghai the one that finally won the right to host the Universal Exhibition 2010.

The fact that MILSET helped with the organization of the science sector at the World Youth Festival in Moscow also tipped the scale in favour of the organization of MILSET ESI 2003 in Moscow.

And the icing on the cake was the city of Saint Petersburg celebrating its 300th anniversary, which allowed the participants to visit the former capital during their stay in Russia.

There were many fairies bent over the cradle of the holiday and they helped gain interest in MILSET ESI 2003 in Moscow, wisely defended by the team led by the Director of the VVC Mr. Magomed Musayev.

As soon as Moscow was designated as the venue for ESI 2003, a working group was created at the VVC under the leadership of the Director of the Exhibition Activities Department of the VVC Mr. Nikolai Bugaev, and under the close supervision of the General Director of VVC, which included Tatyana Shmatkova as well. I was invited to regular meetings of this working group, in which all the leaders of the city's services participated. They talked about technical and financial support and additional activities, as well as the constraints and complexities of organizing and planning. Fortunately, ESI members did not feel any of those difficulties.

MILSET ESI 2003 was announced at the MILSET ESI 2001 in Grenoble, followed by the creation of a preparation committee within the Moscow City Administration, chaired by the Mayor himself, Mr. Youri Luzhkov, who opened the event.

J-C. Guiraudon, M. Musayev, T. Shmatkova and representatives of Moscow administration and VVC

Vice Mayor of J-C. Guiraudon, V. Shantsev, and M. Musayev at the meeting in Moscow City Administration

I would like to tell a story related to the activities of this committee that impressed me. We had already reached the homestretch in the preparation for the ESI by then. I could hardly be noticed behind the splendour of my interpreter[2]. The debates in the committee were heated, and you can imagine my bewilderment whenever the Mayor would ask for my opinion. Nothing could top the mind-blowing moment when he fired the newly appointed VVC CEO in the middle of a meeting. He had not been able to solve the park's recurring street vendors problem in the park area of the VVC I spent a long evening in his office giving him some comfort, and returned to my hotel, which was fortunately not too far.

Fortunately, during the whole affair we were in close contact with the Deputy Mayor Mr. Valeriy Shantsev, a very involved, friendly, highly available and efficient person who was often with us, and helped us find funds for the following:

- Opening ceremony of the VVC That one was also supported by a representative of UNESCO.
- Closing ceremony show.
- Large catalogue to showcase the event.

There was another happy and important consequence of our cooperation with the Moscow authorities. Most of the expenses were covered by the VVC Thus, the ESI's budget was balanced, and a significant portion of participant registration fees were transferred to MILSET's account in France. The devaluation of the dollar against the euro in December 2003 was another pleasant surprise.

Jean-Claude
October 22, 2020

[2] *I would like to pay my dues and express my deepest gratitude to all the interpreters and volunteers who, throughout all my life, have been contributing their talents and enthusiasm to MILSET as well as all the other events or groups I had the pleasure of being a part of during the last half a century… and will be a part of in the future.*

Mayor of Moscow Y. Luzhkov and J-C. Guiraudon at the ESI 2003

J-C. Guiraudon with volunteers' team. ESI 2003

Tatiana Shmatkova

HISTORY OF COOPERATION AND FRIENDSHIP BETWEEN RUSSIA AND MILSET

The MILSET and Russia cooperation and friendship history has been going on for over 30 years and has its own dates, events, and names.

Some of these names are:

Gennady Fokshansky. He was the one who stood at the origins of this cooperation. Six months before the ESI in Brest, he worked as an interpreter with the MILSET delegation in Moscow, when Jean-Claude Guiraudon and Jean-Pierre Triet came to Moscow at the invitation of the Committee of Youth Organizations (KMO). Since then, Gennady forever remained a principal translator and friend of Jean-Claude.

Vyacheslav Makhotkin. A physicist by education, he became the Director of the Central Pavilion of the All-Russian Exhibition Center (VVC), where the first Russian interactive scientific exhibition for children, called "The World of Discovery", was organized with the participation of the Parisian City of Science and Industry La Villette. We then heard, for the first time, that you could "touch science with your hand". Thanks to Makhotkin, the cooperation with MILSET started.

Magomed Musayev. Deputy General Director for the Exhibition Activities of the VVC. Being impressed by new exhibition projects, he wanted to implement them at the VVC. Thanks to him, we started the cooperation with the Parisian centre La Villette, the International Exhibitions Bureau, the Paris-Nord exhibition park, and continued our close cooperation with MILSET, which culminated during the ESI 2003.

ESI 2003 Organizing Committee: V. Krylov, M. Musayev, I. Muraviova, J-C. Guiroudon, T. Shmatkova

COURSE OF EVENTS

1989

The Russian delegation, represented by cosmonaut Igor Volk, Gennady Fokshansky, and Alexander Pavlenko (NTTM club) took part in ESI 89 in Brest (France).

1991

This first contact was followed at the VVC in May 1991, when the leaders of MILSET Jean-Claude Guiraudon and Jean-Pierre Triet, on the occasion of the Week of French Scientific Culture, organized by the French Embassy in Moscow, arrived at the Central Pavilion of the VVC with a group of French schoolchildren to visit the new interactive exhibition for children and youth. It was then that we discovered what MILSET was and who the Petits Débrouillards were.

1992

The Petits Débrouillards program was launched in Moscow with the support of the French animator Joel Quedec, who conducted the first training internships for Russian animators. In the same year, a group from Moscow participated in the Petits Débrouillards camp in Belgium.

1993

MILSET organized an internship for VVC employees at Cité des Sciences in Paris. At the same time, the youth groups exchange live-in families in Paris and Moscow was organized. In the same year, a small group of children led by V. Makhotkin went to ESI 93 in Texas (USA).

1994

Creation of the first Petits Débrouillards clubs in schools, holding the Week of French Scientific Culture in St. Petersburg.

1995

Participation of the Russian delegation in ESI 95 in Kuwait, where we had an incredibly warm welcome in all senses of the word (+40 ^{0}C).

Jean-Claude Guiraudon arrived in Moscow on the occasion of the 50th anniversary of the Victory in The Great Patriotic War. He had a program of meetings at the VVC, participated in the event of the French military mission, on the day of the visit of the President of France Francois Mitterrand.

1996

VVC employees Internship on exhibition organization was arranged in Paris. The French exhibition about water "Bleu Villette" opened at the VVC. The Russian delegation took part in the 1st. MILSET European Expo-Sciences – ESE 96 in Prague.

Opening of the World Youth Festival in Moscow. 1998

1997

Participation of the Russian delegation in the ESI 97 in Pretoria, South Africa, where the idea of holding the Intellectual Festival in Moscow in 98 was announced for the first time (the idea belonged to V. Makhotkin).

1998

The year was very busy and included the creation of a chapter in MILSET: MILSET Russia. The Festival was organized with the participation of 20 countries within the framework of the World Youth Sports Games in Moscow. Then, we participated in ESE 98 in Portugal (Coimbra), as well as the participation of young ecologists in the autumn university in Germany. Finally, we were part of the 1st. Conferences on Scientific Activities in Doha (Qatar).

1999

Signing an agreement on having French travel exhibitions in Moscow, such as "Vineyards and Wine of France" and others. A group of children travelled to Brittany, France to participate in a regional exhibition.

2000

The development of the activities of the Petits Débrouillards clubs in Moscow continued. A trip to Paris for a group of blind Russian children under the slogan "Science in Braille" was organized with the support of the Moscow Government. We also participated in the ESE 2000 in Charleroi (Belgium).

2001

A large delegation went to ESI 2001 in Grenoble, there was a total 75 participants from Russia. It was there that Moscow's candidacy for holding ESI 2003 at the VVC was presented and the agreement with MILSET was signed.

2002

Period of preparation for the ESI 2003, carrying out the All-Russian exhibition of science and technology creativity NTTM in the framework of this preparation. A trip to the Mostratec exhibition in Novo Hamburgo, Brazil to exchange experience.

2003

All those years of work, cooperation, and friendship with the constant support of MILSET, President Jean-Claude Guiraudon, more than anyone, brought us to the pinnacle of our relationship when we organized the Great Meeting of Youth of the World in Moscow: the ESI 2003.

Thanks to MILSET and everyone who contributed to the success of this event, the 2000 participants from 89 countries, as well as the winning team. Here are their names: Nikolay Bugaev, Maria Znova, Julia Smirnova, Vyacheslav Krylov, Alexei Putiatin, Svetlana Reditcheva, Tatiana Belenova, Olivier Dalechamps, Erwan Vapreau, who all were volunteers and animators.

We should not forget some other important people; without their support the exhibition would never have taken place. Therefore, we express our gratitude to Moscow Mayor Yuri Luzhkov, Vice Mayor Valery Shantsev, Chairman of the Committee for Family and Youth Affairs Irina Muravyova, Deputy General Director of the All-Russian Exhibition Center Magomed Musayev and President of MILSET and our great friend Jean-Claude Guiraudon.

After 2003 there were a lot of interesting things: the development of Petits Débrouillards in Russia with the support of the Committee for Family and Youth Affairs, as well as the Russian participation in MILSET Expo-Sciences in Dresden, Tunisia, Chile, Tarragona, and Malta. Still, the first meeting with MILSET at the modest festival of 1998 and the grandiose ESI 2003 are still the most memorable.

Everything is still going on thanks to the emergence and further active promotion of the team under the leadership of Alexander Leontovich, who showed in 2003–2005 a great interest in MILSET. Later on, he took over from the MILSET-Russia department, which, unfortunately, by that time had lost support from the VVC. Still later, the MILSET-Vostok regional office was created and now is actively participating in the life and events of MILSET, enriching MILSET with new projects, participants, and initiatives. I thank them and wish you further successful progress on the roads of MILSET.

T. Shmatkova with the Georgia delegation leader. ESI 2003

A gift to T. Shmatkova form ESI 2003 Team of volunteers (France)

ESI 2003 Participants

ESI 2003 PARTICIPANTS TELL

Joël Le Bras (France)
Head of CIRASTI delegation
at the ESI 2003

Grandiose!

Moscow Expo-Science International 2003 will undoubtedly and rightfully remain in the annals. This event, the ninth ESI organized by MILSET, whose opening was "the greatest day" of this Movement, brought together more than 1600 participants from 80 countries, including a very nice delegation from Russia.

Grandiose is also the word I would use to describe the reception we got from the Organizing Committee and the City of Moscow: a welcoming proportionate to this country and its capital, a city which has the dimension of the entire Ile de France region.

To conclude, here are a few memories and a few words on the ramifications that ESI 2003 had on the future of a volunteer: "Grandiose for me and for all the participants, impressive for its atmosphere of conviviality and benevolence, intellectual, on a large scale all across the board. I have participated in other Expo-Sciences but this one's impact on me was remarkable".

I have been fortunate to participate in other important international events afterwards as a volunteer, including the 2014 Olympic Winter Games in Sochi, and the experience I gained at ESI 2003 is enormously useful for me.

Antoine Van Ruymbeke (Belgium)
MILSET Europe President since 2006
Head of Belgian delegation
at the ESI 2003

If I could sum it up in one word, my experience at MILSET Expo-Sciences International 2003 was just impressive!

It was my third ESI, after being a participant at ESI'99 and a volunteer at ESI 2001, I joined the Russian capital as co-leader of a large Belgian delegation (50 young participants flying to a mysterious land!). I guess I could write a book about all the anecdotes which occurred during that journey but that will be another article.

Hosted within the All-Russian Exhibition Centre, the largest expo ever in MILSET history welcomed participants from all around the world and showcased the capacity of generating an immersive experience full of opportunities. Next to the scientific aspects, we had lots of exchange with the participants creating boundaries which, for some, still remain. We discovered the host country and its culture by extending the stay in Moscow and thanks to a round trip to Saint Petersburg. We lived a memorable adventure!

Personally, it was also my first step within MILSET governance as a young representative of Guy Servers, former Executive Committee member, which is still active after 17 years. It gave me the opportunity to discover the back side of the coin: this place with no boundaries, with the taste and involvement needed to make things happen.

Спасибо, Россия!

Juan Alberto Guevara Jaramillo (Mexico)
Man of the Year 2017 in Mexico
ESI 2003 Participant

My life completely changed in 2003 when I went to Russia to the Expo-Sciences International. This was my first trip abroad and that country turned into my second home. I can say that that is one of the best things that has happened to me. I got to know my future wife and friend with whom we shared great moments.

From the very beginning it was a great experience. Having arrived at Sheremetyevo airport, we realized that all the signs were in Russian so we couldn't understand anything. Obviously, I was impressed with everything I saw, everything was new.

I remember the opening day: while taking photos with bikers I lost my delegation. That day only Mexicans were absent. Really, ESI 2003 was huge, I'd say one of the biggest International Expo-Sciences that have ever been organized. I'm sure everybody remembers the magnificent 'cultural night' when all the countries took part in order to show something special about their countries. Mexicans prepared 2 shows: one was the song ***Besame Mucho,*** and a traditional Mexican dance called ***El Jarabe Tapatio***. We spent

Juan Alberto Guevara at the ESI 2003

2 months preparing the dance and everybody liked it so much that we had to perform it one more time at the closing ceremony.

Once we received a message from the International Space Station from Russian cosmonauts, my friends interpreted it for me because I couldn't understand anything.

I was always wearing my ***sombrero de charro*** from the moment I left the hotel in the morning till the evening. I liked it very much. And once my photo even appeared in a newspaper.

I can say that the Expo-Sciences in Russia had a great impact on the lives of all its participants as well as in the history of MILSET. My close friend Roberto Hidalgo was named vice president. I also had a chance to get to know my friend Jean-Claude Guiraudon. I would love to say thank you to all who participated in the organization of the Expo-Sciences 2003. Without any doubts it was the best Expo in my life.

Fireworks at the ESI 2003

Liz Vela (Mexico)
MILSET Communication manager since 2014
ESI 2003 Participant

MILSET Expo-Sciences International 2003 in Moscow, Russia was an amazing experience!

In 2003 I participated in ESI 2003. It was the second time I attended a MILSET ESI as a participant. Of course, it was fabulous to travel so far away from my home in Mexico because, at that time, I barely knew about culture and life in Russia.

Once I got there, I was fascinated by the landscapes and the welcoming of the organizing committee that assigned us a friend of delegations, who helped us with interpreting and guidance.

I was astonished when we arrived at the Expo and went directly to the opening ceremony. That was amazing, well organized, and colourful with that feeling of happiness and friendship that only MILSET ESI's can cause. All the event was great, the city tours and activities were terrific. The organizing committee continuously checked the participants' needs and did everything to make us feel comfortable and secure.

The closing ceremony was one of a kind with dances and a great surprise from the Russian space agency. It is not that easy to describe all that I lived in that event. Still, I can remember it as one of the best I attended as a participant. This experience defined the person I decided to be. I learned about friendship and that there are no boundaries between countries when you speak the science language and enjoy people. At the end of the trip, I fell in love with the MILSET philosophy and adopted it as part of my daily life.

GENERAL FEEDBACK FROM ESI 2003 PARTICIPANTS

"MILSET's Expo-Sciences significantly changed my life. One day the framework of the school where I was working started to feel too restrictive. Thanks to MILSET I got a taste for participating in Expo-Sciences. I met a lot of interesting people, both Russian and foreign. As a result, I got the idea to create the Scientific Club for children, to make our own site… Thanks to MILSET I have discovered other countries: France, Germany, Slovakia and others…"

"ESI 2003 enabled a very large number of young Russians to participate in this international event, because this time young people from all over the world came to pay them a visit..".

"ESI 2003 became a wonderful celebration for all of us: it was truly international, with a rich cultural programme, an impressive number of foreign participants, visits from eminent people like renowned scientists and the Mayor of Moscow …"

"The young people made new friends. There were no linguistic or geographic barriers".

"The "Petits Débrouillards" space allowed us to present our activities in all their glory".

"The fondest memories of our days together at ESI 2003 will stay with us for a long time!"

"I will not soon forget ESI 2003!" "It was the first time that the Spanish Club and we presented our joint project. We had met in Bratislava and spent the whole year working together to prepare this project, which was truly exciting".

"There was enough space at ESI 2003 like never before, like nowhere since, and we managed to present all of our projects well, even the great maze of cereals!"

"For us it was a meeting between friends that allowed us to make lots of plans for the future ..".

"The atmosphere was great! It was a never-ending party!"

"Lots of original ideas, interesting projects, all well-presented and of high quality, useful for broadening our horizons…"

"In my opinion, the ESI is a unique and well-designed event that allows young people of the same age to meet, talk and have fun".

"It was our first time visiting both Moscow and the ESI. It's great! Honestly, we've never seen anything like this. Our deepest respect from Astana!"

"Thanks to ESI 2003 we discovered Moscow. It's a very beautiful city, especially Red Square … ESI 2003 was a real success because it gave so many opportunities to connect with new people!"

"…My personal impressions: the scale of the exhibition, the jovial atmosphere, Moscow circus, the girls, the Exhibition Center and also… well organized".

MILSET Executive Committee at the ESI 2003

ESI 2003 ORGANIZERS TELL

Olivier Dalechamps (France)
Volunteer at the ESI 2003 responsible for animation and rocket workshops

That International Expo-Sciences was an exceptional event for the youth of the world. Perfectly organized, that ESI was a great gathering of the scientific and technical youth of the world, but more than that, it was above all a great gathering of young people in search of hope and peace. The feedback we got from young people during the congress organized at the ESI showed it very well.

Many want to become scientists, the great majority believe that science can solve the world's problems, but above all they want science to serve the cause of peace and create a better future for mankind.

Science for peace and people's development, this is the message that I will take from this Expo-Sciences.

The "Friends of the Delegations" played an important role in the success of this event. The executive team was formed in France and Slovakia with Mr. J. SIPOS's help during the years 2002–2003.

The young volunteers who joined them ensured the success of the event with their hard work, hospitality, and enthusiasm. A total of 180 people, students from the universities of Moscow, but also young people from Slovakia, France, Belgium, and the Czech Republic formed for the first time an international team of volunteers, a team of true friends of the delegations for 2003's ESI. They are the ones we have to thank for this unforgettable atmosphere. They provided translation to the delegations into their national language.

Olivier Dalechamps with group Mini-Rockets Workshop participants at ESI2003

Grégoire Bertolino Padilla (France)
Volunteer at the ESI 2023

I was just 18 when I left Marseille for Moscow during the summer of 2003. It wasn't my first ESI as a volunteer, but that one felt differently.

When I arrived in Russia, I could feel the whole city was pushing this event forward. After a few days, once every delegation arrived and the ribbons were cut, I knew that would be one of the greatest adventures of my life. We experienced many emotions together: excitement, happiness, fear (yeah, we had to go through one bomb alert, these were troubled times).

Every time I look back to those memories, I see Tania Shmatkova's sweet smile, and I hear a little music that just makes me want to dance and go back in time "Only peace, only music…". I've lived many other ESI's (97, 2001, 2009, 2011, 2013, 2015), but Moscow 2003 has a special taste to me. I hope one day I'll be back there with my kids and show them the magic I experienced when I was younger!

Gregoire Padilla and group of French Volunteers at the ESI 2003

Carole Charlebois (Canada)
General Secretary &Treasurer of MILSET, former Vice-President
Assistant General Secretary of MILSET in 2003

Who would forget the quality of the ESI 2003 in beautiful Moscow?

The host committee amazed us with the quality of its organisation and activities, the cultural and closing ceremonies, and its warm welcome. I will never forget the quality of the friends of delegations and their ability to speak so many different languages.

I felt really at home. Numerous visitors and scientists allowed our young participants to share their interest in science and technology. The Canadian delegation was dazzled by the splendours of Moscow and took home many memories.

The ESI 2003 raised the quality standard of this great gathering of young scientists, a challenge for future editions.

Carole Charlebois in Moscow at ESI2003

ESI 2003 Opening

Project Exhibition at ESI 2003

ESI 2003 participants

OTHER FEEDBACK FORM ORGANIZERS

"... to see at the same time and in the same place more than 2000 young people from all over the world with their projects, beautiful and happy to be all together at ESI 2003 in Moscow..".

"Preparation work during night-time, phone conversations with Russian consulates on other continents, ... could you make it easier to get visas, please? The result: every single participant got their visa. And free too!"

"Exceptional efforts were undertaken to bring in 4 young people from Mali with their project on 'improved homesteads.' They faced many problems organizing the trip from their country, but they finally arrived on the last day of the ESI".

"During all the hard and joyful moments, we had the invaluable support of the French animators Olivier and Erwan..."

"The storm approaching during the great outdoors opening ceremony, the black sky promising the downpour; a bit of panic, the umbrellas brought for the officials, the ceremony almost failed, but the storm spared the Expo Center, left to pour its rain elsewhere and let us continue our celebration, what a miracle!"

"The delegation from Reunion Island (the young people who live near a volcano) were lucky to be the last to leave, and we had time to get to know each other, discuss, visit the City of Stars together..".

"The pleasure of introducing the ESI 2003 participants to the beauty of St. Petersburg...".

"The human qualities, the goodwill, the hospitality and the courage of the volunteers: the true friends of the delegations".

Appendix 1

ESI 2003 REPORT

T. Shmatkova,
Manageress of the ESI 03, Moscow

1 – Dates and place

The 9th International Expo-Sciences of scientific and technical projects of young people, the ESI 2003, was held from 12 to 18 July 2003 in Moscow in the All-Russian Exhibition Center (VVC).

The fair occupied the pavilion N°57 of the VVC on a surface of 13 000 m² with two fitted esplanades and a podium outside for ceremonies and festivities. All the park was open to the participants.

Its subject: "The Young hold the Future of the Planet in their hands"

2 – Organizers of the ESI 2003

- International Movement for Leisure Activities in Science and Technology (MILSET).
- The City of Moscow, the Government of Moscow.
- The All-Russian Exhibition Center OAO "GAO VVC"..

Three agreements were signed between these partners.

3 – Number of participants and of countries

2. 015 young participants from 7 to 23 years old and their leaders coming from 88 countries of the world, 87 regions of Russia. 863 foreign participants, 412 participants from Russia's regions, 560 Muscovites and 180 volunteers.

4 – Agenda of preparation

July, 2001, Grenoble. MILSET's decision to organize the ESI 2003 in Moscow and signature of the Protocol of attribution between VVC and MILSET.

December, 2001, Moscow. Signature of the General Agreement on the organization of the ESI 2003 between the City of Moscow and MILSET.

July, 2002, Moscow. Organization of the Fair NTTM 2002 as a preparation of the ESI 2003, participation of the leaders of MILSET and Planet, Science Brittany to the Fair.

December, 2002, Moscow. Appointment of Mr. Magomed Musayev as General Commissioner of the ESI 2003 and creation of the Executive management.

December, 2002 – January, 2003. Mission of Olivier Dalechamps for the workshop activities.

January, 2003, Moscow. Signature of the Agreement on the organization of the ESI 2003 between the OAO "GAO VVC" and MILSET. Creation of the Steering committee.

January 27, March 03, April 28, June 06 and July 04, 2003. Meetings of the Steering committee of the ESI 2003, chaired by Mr. Yuriy Loujkov, the Mayor and Valeriy Shantsev, Mayor first assistant.

April 23, May 23 and June 17, 2003, Moscow. Meetings of the operational group steered by Mr. Iosif Ordzhonikidze, Vice mayor.

June, 2003. Organization of rooms, spaces, and podia.

July 2, 2003. Installation of the

organization teams and of the group leaders "Friends of the Delegations". Setting up of the reception by the V. Krylov's teams.

July 4, 2003. Promotion and installation of signposts in the city and in the VVC.

July 8, 2003. Arrivals of delegations.

July 12–18, 2003. Progress.

July 19, 2003. Departure of delegations.

July 19–22, 2003. Journey to Saint-Petersburg.

July 21–30, 2003. Dismantling and reinstatement of materials and spaces.

5 – Russian participation

About 1 000 participants of all Russia's regions, 500 projects, 67 higher education establishments and universities, 33 secondary schools, 37 scientific and technical activities centres of young people.

The coordination of the preliminary document was assured by the Ministry of Education, the Education Department of the city of Moscow, the Committee for family and youth Affairs of the city of Moscow.

Registration fees were 2000 roubles as well as for the participants coming from countries of the CIS.

6 – Foreign participation

88 countries, 863 participants of 127 organizations and associations, including the international organizations UNESCO, PRELUDE, Schlumberger Foundation, with 340 projects.

Invitations were spread, even in a difficult period (war in IRAQ, the SRAS epidemic in Asia):

- The network of MILSET's organizations
- The official services of the City: a written invitation of Moscow's Mayor was sent to the Mayors of more than 100 cities of the world,
- Embassies accredited in Moscow and the Moscow Patrice Lumumba University of the People's Friendship.

Registration fees were 200 dollars US. See appendix.

7 – Activities

The French association Planet – Sciences Brittany and MILSET realized 4 workshops activities for the public in the following topics:

- Genetics. "All same, all unlike".
- Archaeology. A simulation of an archaeological site of the Neolithic.
- Robotics. With a technical ALGORO program, genetic algorithms.
- ***Micro rockets*** workshop.

8 – Village of the Petits Débrouillards

It was high quality design and organization. One of the most visited and appreciated places by the public and the participants. Situated on a surface of 2, 000 m^2 with 164 participants coming from 8 countries. That is to say, 135 Russian participants and 29 foreigners of 21 clubs and associations, 14 Russian clubs, and 7 clubs and foreign associations. The responsible for clubs dealt of the development of the cooperation between Petits Débrouillards clubs and decided on permanent exchanges of information and setting up of a common project for Expo-Sciences.

9 – Program of visits

The Program contained 14 thematic visits: Centre of management of aerospace flights (TSUP), Training centre of the cosmonauts "City of stars", aerospace company Khrounitchev, cosmonauts' memorial museum, museum of the military forces, Institute of nuclear Research Kourtchatov, Darwin museum, biology Timiriazev museum, national reserve

"Island of elks", greenhouse "Belaya's datcha flowers", zoological garden, historic Centre "white Palace on Pretchistinka".

All the participants went on a tour around Moscow, a visit of the Kremlin and the circus of Moscow.

10 – Catering

Three meals a day were assured from July 11–19 (a buffet on the 11th and a lunch on the 19th). Breakfast was served in the hotel, lunch and dinner for 2000 persons in the restaurant of the VVC Five Seas, in the pavilion Fishing n° 38. To allow the service to take place from 12.00 until 14.00, a shuttle bus circulated between the Fair and the restaurant. Every group of 40-45 persons was accompanied by its "Friend of Delegation". The rooms of the restaurant were served by 100 waiters for 200 tables.

11 – Transport

The whole transportation during the ESI 2003, from 11 am until 7 pm in July, was assured by "the yellow buses", school buses made available for the organization by the Department of Education of the City of Moscow. The movements in the city were done in convoys lead by police cars.

Shuttles assured the safe return to hotels in the evening, mainly the hotel Voskhod, located in the North part of the park, 5 km away. This service worked well in spite of its great workload.

12 – Accommodation

1,325 people were accommodated in 4 hotels near the exhibition park: The Tourist hosted 700 people, The Voskhod, 200 people, The Baykal, 400 people, and The Cosmos, 25 people, all of them delegations of MILSET.

13 – Visas

This complicated work was organized in common with the services of the City of Moscow and the Ministry of Foreign Affairs of the Russian Federation.

Two people followed the file from April. The objective was not to interfere with the participation of the ESI 2003. In the end, 820 demands of visa all granted.

14 – Debates and Congress

The Congress ***Young – Sciences – Society*** became the most important and significant part of the program of the ESI 2003. It was strikingly realized by the team managed by Mr. N. Bugaev.

It was preceded by events proposed by the Russian organizers and MILSET. Following the Congress of Grenoble in 2001 and Bratislava in 2002, it represented, by its contents and its magnitude, the most successful Congress of the history of MILSET's International Expo-Sciences. The following are some facts about it:

Debates on the subject ***The Young hold the Future of the Planet in their Hands*** was the continuation of debates proposed by CIRASTI in 2001 in Grenoble. The subject ***The Young Question Science about their Future*** drew attention of the young from various countries.

Important contributions came from 20 countries and 15 regions of Russia. 1700 participants in debates from 10 to 23 years old expressed more than 10, 500 different opinions on 11 questions asked by the organizers. The analysis of these answers showed the preoccupation of the young about their future and that of the planet.

The competitions of summaries and drawings received more than 1,000 works and rewarded 27 winners.

The organization of round discussions during Expo-Sciences in the pavilion n° 57 turned as follows: There were 9

events chaired by scientists and professors from the universities of Moscow.

The closing session of the Congress on July 17, 2003 took place in the Large Room of the Academy of Sciences of Russia and assessed all the constitutive parts of the Congress. The Assembly was chaired by the Minister of Education and Science of Russian Federation Vladimir Filippov, the cosmonaut Alexey Leonov, the Chairman of MILSET J-C. Guiraudon, the General Secretary of the International Board of Exhibitions Mr. Vicente G. Loscertales, and the General Commissioner of the ESI 2003 Magomed Musayev.

The resolutions from ESI 2003's young participants and its Congress were sent to the Heads of States and to the international organizations.

The press conference which followed the closing ceremony of the Congress brought together 35 journalists.

Before their departure, a remarkable report, a luxurious publication in four colour printing of 320 pages in three languages was handed, accompanied with a CD, and was given to all the participants. This work was led by Mr. Alexey Salaschenko, Director of the VVC Exhibition Complex "Science and Education".

15 – Scientific Committee

The Committee of 34 people was chaired by Mr Victor Sadovnichiy, Rector of the Lomonosov Moscow State University, with personalities from the Russian Academy of Sciences; members of the Academy of Agriculture; the international Academy of Engineers; the Academy of Educational and Social sciences; the Academy of Sciences of Man and Nature preservation; the International Academy of Computerization; and the Chief Education Officers from universities and institutes of scientific researches of Moscow,; responsible for federal and municipal organization.

The members of the Scientific Committee visited stands and talked to the participants of their projects during all Expo-Sciences.

16 – Ceremonies and shows

They represented unforgettable moments: the opening of the ESI 2003, with the cooperation of the Mayor of Moscow Mr. Luzhkov; of Ms. Maud de Boer-Buquicchio, Deputy Secretary General of the Council of Europe; and Mr. Vicente G. Loscertales, General Secretary of the BIE. The delegations' evenings, the traditional festival, and the closing ceremony with the fireworks all were strikingly organized by Mr. Bougaev and his co-workers.

17 – "Friends of the delegations"

"Friends of the delegations" played a determining role in the success of the event. The responsible team was formed in France and in Slovakia with Mr. J. Sipos, during 200–2004.

The young volunteers who joined them were assured by their relentless work, their hospitality and their enthusiasm. The result was the success of the event. There were 180 people, many of them students from different universities of Moscow, but also young coming from Slovakia, France, Belgium, and Czech Republic. All of them formed, for the first time, the international team of the volunteers, the team of the true friends of the delegations of the ESI 2003. It is thanks to them that we had this unforgettable atmosphere during the ESI 2003. They assured translations for the delegations in their national language.

18 – Security

A particular attention has been drawn to the problem of security. The services of the City of Moscow, together with those

of the VVC, assured this work with 425 effective and discreet co-workers as had asked them the Mayor. The organizers are grateful to the participants of the ESI 2003 for their understanding. There was only on difficulty: some thefts of computer materials on stands during opening hours.

19 – Program After the ESI: Saint-Petersburg

240 participants of the ESI 2003 prolonged their stay to visit Saint-Petersburg. The city celebrated its three hundredth anniversary. They appreciated a lot the program organized by T. Shmatkova and M. Znova from MILSET Russia: city tour, visit of the Hermitage's museum and Petergoff's palace with its caves and its park.

18 – Publications in media

The marketing was very important under the responsibility of the services of the City council. There were 155 articles published in the press, including "Moscow of evening", "Tverskaya, 13", "Technique to the young people", "Sciences and Life", "Young engineer", "Young scholar", "Intellect – Creativity", "To the world of sciences", "Investments and Management", "Sciences of Moscow and regions", as well as on Internet sites like www.km.ru, and www.Cnews.ru.

Information about the ESI 2003 appeared on the following:

150 Web sites, including those of the Government of Moscow, UNESCO, the Academy of the sciences of Russian Federation and the Universities.

26 television channels – ORT, RTR, NTV, TVC, Culture, Stolitsa, as well as regional channels of Russia and countries of the CIS.

We organized 18 programs on the television and a series of interview on Stolitsa, the one of Moscow, as well as on the radios Way of Russia, Radio of Russia, Echo of Moscow and Here Moscow.

350 journalists were accredited to the ESI 2003, and we organized 3 press conferences.

Posters and signs ESI 2003 were installed everywhere in the city.

19 – Budget

This one was almost entirely supported by the City. It was US$ 2,334,000.

The transfer to MILSET of 50 % of the registration fees of the foreigners was US$ 57,104.

See appendix.

20 – Consequences of the ESI 2003 for MILSET, Russia and Moscow

NTTM Fair:

The preparation of the ESI 2003 in 2001 – 2002 revived the national fair of the KOMSOML of scientific and technical activities of young people "NTTM", abandoned since 1990.

The decision to organize this fair annually was taken by the City of Moscow in December, 2003. The next fair NTTM would be held from on July 7–14, 2004 in the pavilion of the ESI 2003 and would be organized according to its model. It expected 1000 participants from Moscow and Russia regions.

Petits Débrouillards:

The activity of the Petits Débrouillards existed in the VVC since 1991 with many difficulties and thanks to the enthusiasm of a group of leaders.

The Committee for the Family and the Youth Affairs of Mrs. Irina Mouravieva, very involved in the organization of the ESI 2003, put the Petits Débrouillards in the list of activities supported by the City of Moscow. They had their premises and the grant of a subsidy for the payment of its director.

The national Association of the Petits Débrouillards of Russia was officially created on February 15, 2004.

Today the clubs of the Petits Débrouillards applied to the competition of activities for the children, organized by the City of Moscow.

Congress:

The Congress ***The Young hold the Future of the Planet in their Hands*** were important moments for the young Russians and allowed the young people to discuss, to express themselves and to exchange points of view in a free and democratic way, but also to reflect on their future.

The application of resolutions led MILSET to define ***The Young and the Society of Communication*** as priority subject for 2004–2005. After the ESI 2005, a great event took place in Tunis in November 2005 with the ***Summit of the Scientific Youth*** interested in connection with the ***Summit of the Heads of State***.

21 – Groups of experts and volunteers

The groups of experts and volunteers worked very well. In January 2004, the leaders met for the second time in Moscow with the participation of Martin Kustek from Slovakia. A summer session was organized in August 2004. The volunteers of the participating countries at the ESI 2003 were invited there.

Virtual Fair

The prototype of the Virtual Fair was realized by the group of V. Krylov. It had to be developed during 2004 to be ready for the ESI 2005.

MILSET Russia

The fame of MILSET was considerably increased with the arrival of new members and the good appreciation of our partners.

Our relations with the City of Moscow and the VVC were excellent and MILSET Russia was recognized. We prepared the installation of an Institute for the Informal Education in Sciences in MOSCOW.

We were partners of the project of "City of the Sciences", which developed in the VVC We established relations with the B.I.E for a participation of young scientists in international and universal fairs.

Our relations with UNESCO and ALECSO had to be developed as well as with the European Commission.

ESI:

We had a very important collection of documents and images as support of learning on the organization of Expo-Sciences, the procedures of registrations, the agreements to be established with the partners, the regulations for the participants, and they were in several languages.

All this practical knowledge and this documentation would be used to help to the organization of the ESI 2005, assigned to the Colegio de la Salle, in Chile.

We had 5 hours of video recordings which could be used to realize a film on DVD as a report.

We had the data of 2000 participants and their organizations.

Appendix 2

International Youth Scientific Congress "The young people hold the future of the planet in their hands" at the ESI 2003

ADDRESS OF YOUTH TO HEADS OF STATES AND GOVERNMENTS OF THE WORLD[3]

We, participants of the 9th International Exhibition of Youth Scientific and Technical Projects EXPO-Science 2003, and the International Youth Scientific congress "Youth. Science. Society", representatives of 100 countries of the world, address heads of states and governments of the world, leaders of international organizations and all those caring about the future of our planet.

We, young people, possess an incredible intellectual potential. We are sure that the future of the planet is in our hands. We are capable of creativity; we are open to education

[3] *This Manifest was made as a resolution of the Congress "The young people hold the future of he planet in their hands" that was organized for young people in the age of 12 to 20 years old in period from November 2002 to April 2003. The series of debates took place in Youth associations to determine the opinion of the youth about the problems of preservation of our planet and creation of equitable societies in the 21st century. During the ESI 2003 in Moscow in 2003, all opinions were studied and a resolution was prepared for voting at the Congress. The Address was transmitted to the States and to the united structures like the United Nations.*

and progress. We are ready to become active participants of transformation of the present-day world community in the name of its prosperity. We are working to become active participants in this process.

During the days spent in discussions and meetings with well-known scientists, political and public figures, we discussed the overwhelming possibilities of modern science. Today's technologies are capable of solving fundamental problems of humanity: shortage of food and water, shortage of sources of energy, protection of the environment and many other issues. However, science is not omnipotent. It is defenceless in its childhood age, just as we are, in front of expressions of violence and aggression, where the wonderful new achievements of science are used for purposes that are far from peaceful. This is especially dangerous today when accumulated achievements of science and technology could either bring humankind a gracious shower of benefits, or could destroy every living thing on the planet. This is why, ***We address you with an appeal to develop a new concept of preserving world peace as the only sensible way of development of mankind.***

We call upon you to hold a special summit meeting of heads of states on the issues of education and development of science. This summit will attract attention of state authorities, political parties, and the general public to the issue of creating beneficial conditions for creative, scientific activity of the youth, and for implementing initiatives of young people in all areas of human living.

We hope that this summit will mark the start of collective creation of a "law of universal peace" and that consequences of this law will exceed the great discoveries of Einstein, Newton, and Curie. The formula of this law contains recognition of values of human life as an absolute priority, harmonization of relations between poor and rich countries, and cooperation in joint construction of our common home Noosphere, the Earth. Using this law as the foundation, nations of the world will unite like mighty flowing rivers and will find the new direction for their creative efforts, the creation of a new human civilization. This law will further expand the horizons of scientific research and will bring magnificent new discoveries.

We propose to create a Worldwide Supervisory Council for youth issues, to elect every five years a city to become the world's capital of youth. We propose to first give this honourable right to the city of Moscow.

We firmly believe that a majority of people in your countries expect from you, political leaders and heads of states, actions aimed at supporting world peace and creation of best conditions for developing creative activities of young people. Please take those steps that are expected of you and start those actions today!

Participants of the 9th International Exhibition of Youth Scientific and Technical Projects, Expo-Sciences 2003 and International youth scientific congress Youth. Science. Society