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## SCIENCE LITERACY AS THE TOOL FOR SURVIVING IN THE CHANGING WORLD

**Abstract.** *The objective of this article is to create background for providing research in science literacy area. Authors suggest ideas for extension of science literacy with the aim to save Ukrainian leading position for this direction in the world. Short information about the presentations on World Conference on Science Literacy is given. The Conference was organized by China Association for Science and Technology jointly with UNESCO and World Federation of Engineering Organizations in Beijing in 2018. Authors' definition for science literacy and grounding for extension of research in this direction are given. Some recommendations are added for coordination of international cooperation for using science literacy as the tool for surviving in changing world.*

**Keywords:** *science literacy, information, knowledge, methodology, paradigm, new human being.*

### INTRODUCTION

Our world is changing rapidly. Thus, UN created program with the name: 17 Sustainable Development Goals [1]. **The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all.** It is evident that this program will use innovations, like robotics or artificial intelligence, for its realization. Humans also should be changed to match future challenges. It should be something like “universal tool” for: a) soft preparation for future changes; b) covering all “categories” of humans: politicians, technicians, ordinary people, children and etc. We do believe that Science Literacy is one of the best candidates for such universal tool.

The majority of us already are the part of Science Literacy process, e.g. by watching Discovery Channel on TV. Recent World Conference on Science Literacy (Beijing in September, 2018 [2]) had the aim to exchange knowledge and also to make some systematization on the subject.

Historically Ukraine created many initiatives, which got name Science Literacy now. Based on the results of the discussions in Beijing, we still are on the leading positions.

By this article we plan to share some ideas about Science Literacy and to start the discussion of how to save Ukrainian leading positions in Science Literacy in future.

### SCIENCE LITERACY CONFERENCE IN BEIJING

World Conference on Science Literacy was organized jointly by China Association on Science and technology (CAST) [3], UNESCO and World Federation of Engineering Organizations [4]. Conference gathered more than 1,500 scientists from 40 countries, including the US, Australia, Germa-

ny, Japan, UK, Canada, Ukraine and etc. There were 4 Nobel Prize Winners, who presented their ideas on this Conference. Welcome letters from: Mr. Xi Jinping, leader of China; Mr. Antonio Guterres, UN General Secretary; Mrs. Audrey Azoulay, UNESCO General Secretary; Mrs. Marlene Kanga, WFEO president were announced during opening ceremony.

Conference approved Beijing Declaration, which we attach in its entirety. Beijing Declaration adopted by the World Conference on Science Literacy (Beijing, China, September 17–19, 2018). Participants from 37 countries or regions at the World Conference on Science Literacy, meeting in Beijing from seventeenth to nineteenth of September in the year two thousand and eighteen, carried out in-depth exchanges on “Science Literacy for a Shared and Better Future”, hereby make the following Declaration:

1. Human beings are interdependent members of a global community who live together on the Earth with a shared future. We are faced with many common challenges, in a world full of hope, such as development gap, severe diseases, climate change and environmental pollution. Recognizing that no country alone can address these challenges, Exchanges and cooperation among different countries should be strengthened to achieve the UN Sustainable Development Goals and to promote the common progress of mankind.

2. Promoting the positive interaction between science and technology and the society. Science and technology have brought fundamental changes into all aspects of human production and life at unprecedented speed, breadth and depth. Science and technology contribute to the progress of human society and enrich people's spiritual world, yet they also carry risks and uncertainties

that we cannot afford to ignore. Research integrity should be promoted to ensure that the general public understand and be involved in science, the value of science and technology are fully realized, and science and technology serve the overall and long-term interests of mankind.

3. Missions and values of promoting science literacy. It is noted that science literacy is an intrinsic requirement for individuals' all-round development, the social foundation for a nation's innovation capacity and sustainable development, as well as the intellectual foundation for the mutual understanding and peace of human society. As a combination of science and technology, reason and romance, science literacy not only involves the mastery of scientific knowledge and scientific methods, but also reflects the respect for and the pursuit of scientific spirit and scientific thinking. The improvement of science literacy is concerned with both individuals' and nations' future as well as human beings' wisdom and capabilities in coping with varied risks and challenges and building a better world.

4. Status quo and challenges. Recognizing the unbalanced development of public science literacy across the globe and the poor access to the benefits of modern science and technology due to this, the international mechanism for science literacy exchanges and cooperation is yet to be strengthened, as it is still far from being able to achieve the UN Sustainable Development Goals and to meet the expectations of people around the world for common prosperity and development.

5. Closely coordinated networks. Science and technology organizations play a unique role and shoulder irreplaceable responsibilities in the promotion of public science literacy. We call on all relevant parties to take action toward an effective mechanism: governments should strengthen policy support and resource allocation with a strategic vision; scientists should share their findings and insights in a timely and responsible manner; educators should provide better science education; entrepreneurs should bring diverse and substantial momentum into the promotion of public science literacy; media should disseminate scientific spirit, ideas, knowledge and methods more responsibly, professionally and widely, to ensure better public understanding and support of science.

6. Promoting universal benefit and fairness. We call on governments to attach greater importance to the promotion of public science literacy, especially to protect and stimulate the interest of the younger generation in science, help the poor to narrow the gap in science literacy in order to bring them hope and opportunities to get rid of poverty, and enable women to fully enjoy the dignity brought by the improvement of science literacy.

7. Filling in the global science literacy gap. We hope that scientific and technological achievements will be shared by all human beings and that public science literacy can be improved universally. Governments should vigorously promote the education, dissemination and popularization of science and eliminate the barriers to the sharing of scientific knowledge in a fair and mutually beneficial manner. We call on actions to include the promotion of public science literacy into the UN's agenda on sustainable development, fill in the gaps in knowledge and development and the digital divide in the information age, and promote inclusive, universally beneficial, and sustainable development.

8. Building mechanisms for cooperation and sharing. We call on close international exchanges and cooperation to share experiences and resources and to build effective mechanism. We welcome the establishment of an international organization to achieve shared growth through discussions and collaborations.

Let us jointly achieve the harmonious unity of science and technology with humanities, society and nature, promote human development with science and technology, and create a better future for mankind.

It is impossible to give full description of ideas presented on the Conference, Proceedings of which are available on CAST web-site (electronic version) and in USEAU office (hard copy). Instead of this, we would like to stress two statements, which are important for further description.

1. There were many discussions at the conference about the audience for science literacy: Prof. Polyakoff from Nottingham University considers Science Literacy for cultivation of new scientists mainly. Prof. Holt, Science Chief Editor has another vision: Earth sustainable development is impossible without Science Literacy for all ordinary people. Authors' vision is based on Beijing declaration and we think, that it should be a multilevel system for covering all ages and all categories of humans:

- Young people as future engineers and scientists;
- Young people as promoters of Science Literacy for their relatives and friends;
- Ordinary people of different age, like farmers, humanitarians and housewives;
- Technicians/Engineers, etc;

2. At the same time we want to forewarn from potential mistake. We see the threat of transferring Science Literacy into "disabled person". It seems that initiators of STEM initiative (Science + Technology + Engineering + Mathematics) [5] planned to have balance:  $S+M \cong E+T$ . But, it seems, that present STEM looks like STEM for the countries

with efficient technology transfer systems or even like STEM for other ones. Or, in other words, it has one normal (Scientific) leg and a “wood prosthesis” instead of the second one (Engineering).

### INTRNATIONAL TOOLS FOR SCIENCE LITERACY

**Literacy web site.** It was clear from the conference presentations that majority of countries/players are using the set with limited number of tools. The total list is the following:

a) “Academic” technical museums, which contain very deep and comprehensive information, but they are tedious and unattractive. As the result most of them have only few visitors/day;

b) New generation of museums of science (both private and public). They are oriented on playing games with visitors and are very attractive for young people [6];

c) Different sections for both non-formal and in-formal training [7]. We also would like to add discussions about new types of thinking/learning [8] to this part. Because of limited size of the article we would like to refer to appropriate discussion [9-13];

d) Internet and TV resources, like You Tube, Discovery Channel and etc.

Many countries have the full set of above tools; some countries use only few ones. There are local “inventions” in some countries, which increase the efficiency of regular tools. Thus, common platform for information exchange looks natural. It can be International Science Literacy web-site for such exchange. The simplest web-site should contain: a) boxes for each country with similar structure and b) regular means for communications. Ukrainian delegation proposed to create such web-site and this proposal was included into the list of conference decisions. Such simple web will be inexpensive, but, unfortunately, its audience will be limited.

**Mandatory course: Introduction for engineering.** The best age to attract interest of young people to engineering is around 14. To that time they have obtained some basic knowledge in natural sciences and didn't lose interest to do something by their hands. This statement was confirmed after the discussions on the number of seminars, which was organized by USEAU in the last years.

It is proposed to create **mandatory course** for pupils of 7 (or 8) year of study with the name: **Introduction to engineering.** The objective of this course is to launch “love to technique” (as the part of Science Literacy) for all pupils. The course content can be the same for any country, because it hasn't strong coordination with school programs for other disciplines. Thus, there is no problem with the audience. The problem is how to make course interesting for readers. For example, present pupils

have specific type of thinking with the name: clip thinking, which requires new ideas for realization. Let's use analogy. New course should be analogous to new science museums (item b in above chapter) instead of classic museums (item a).

The mandatory course might be continued by learning of existing variable courses on the year after the mandatory course. The examples of variable courses are: Introduction to computer science, Robotics, Engineering Design, etc.

The group of technically oriented young people can continue their “friendship relations with technique” in specialized sections in parallel or after the completion of the above courses. In-formal learning by use the tools from above chapter is open for all the rest.

**Technical Training for post-graduates.** The main part of activity of Union of scientific and engineering associations during many years was post graduate training. And we were staying ahead in this area compare to the technical federations in many other countries. Post graduate study with “fashion” acronym CPD (continued professional development) became very popular worldwide now. We do believe that Science Literacy for engineers should be added to the regular CPD trainings.

Just few examples: energy saving technologies in construction industry. The list of such technologies, which are available on the Ukrainian market, is very limited. The same time, modern photovoltaic, for example, includes not only specialized construction (solar cells) on the roof. Developed countries have new type of industry with the name: Integrated photovoltaic. Tiles for the roof, bricks for the walls, glasses for the windows, which are solar cells the same time, are only few examples of new industry production. New material for the floor can accumulate energy from day light and use it for heating house at night. The list of examples can be continued. One can consider all of these examples (or similar ones for other categories of engineers) as Science Literacy for post-graduates.

We do believe that extension of regular training course by Science Literacy part will adds credibility to it and as well completes covering of all categories of Science Literacy audience (see Chapter 2, above).

### CONCLUSION: STRATAGY FOR FURTHER DEVELOPMENT

Let us stress again the international component of above proposal. All above tools can be used in many countries in almost the same format. That is why; the almost same activities should be used for support and improvement of these tools. For example, any country can create Science Literacy web-site (See above). One should include systematiza-

tion, analysis and correction of primary information, promotion of the best practices, etc. to make this web-site more efficient. At the same time “larger” web-site will require larger team for its support.

We guess that adequate format for this larger web-site can be the following: **Science Literacy International Laboratory with branches in all involved countries**. It looks natural for us, if preparation and promotion of mandatory manual “Introduction for engineering” as well as new post graduate courses will be the next objectives of Science Literacy International Laboratory.

USEAU started the discussions about Science Literacy International Laboratory with our partners: technical federations in China and in Czech Republic. Thus, the process was launched.

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### НАУКОВА ГРАМОТНІСТЬ ЯК ІНСТРУМЕНТ ВИЖИВАННЯ У СВІТІ, ЩО ЗМІНЮЄТЬСЯ

**Резюме.** Метою статті є методологічне обґрунтування необхідності досліджень у сфері наукової грамотності, викладаються ідеї щодо розвитку та пропаганди наукової грамотності для збереження лідерства України у цьому напрямі в світі. Надана стисла інформація про доповіді, зроблені на Всесвітній конференції з наукової грамотності. Конференція була організована Китайською асоціацією з науки та технологій (CAST) спільно з ЮНЕСКО та Всесвітньою федерацією інженерних організацій у Пекіні в 2018 р. Надано авторське визначення терміну “наукова грамотність”, а також обґрунтування необхідності розробки наукової бази у цьому напрямі. Наведено рекомендації для координації зусиль світової спільноти, що будуть спрямовані на формування наукової грамотності як інструмента виживання у світі, що змінюється.

**Ключові слова:** наукова грамотність, інформація, знання, методологія, парадигма, нова людина.

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### НАУЧНАЯ ГРАМОТНОСТЬ КАК ИНСТРУМЕНТ ВЫЖИВАНИЯ В МЕНЯЮЩЕМСЯ МИРЕ

**Резюме.** Целью статьи является методологическое обоснование необходимости исследований в сфере научной грамотности, излагаются идеи по развитию и пропаганде научной грамотности для сохранения лидерства Украины по этому направлению в мире. Приведена краткая информация о докладах, сделанных на Всемирной конференции по научной грамотности. Конференция организована Китайской ассоциацией по науке и технике (CAST) совместно с ЮНЕСКО и Всемирной федерацией инженерных организаций в Пекине в 2018 г. Дано авторское определение термина “научная грамотность”, а также обоснование необходимости разработки научной базы по этому направлению. Приведены рекомендации для координации усилий международной общественности, которые будут направлены на формирование научной грамотности как инструмента выживания в меняющемся мире.

**Ключевые слова:** научная грамотность, информация, знания, методология, парадигма, новый человек.

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