Dear participants!

You are now viewing the introductory part of a series of presentations on open science designed for recipients of the ÚNKP scholarship.

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Open Science[i], most commonly referred to as "nyílt tudomány" in Hungarian, is a rather complex concept. Independently started various initiatives, movements, research attitudes have formed a cohesive research ecosystem with help of developments in information technology. Its origins date back to the second half of the 20th century. The purpose of this introductory presentation is to provide context for the Open Science training you are about to embark on.

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The Brief History of Open Science

The development of the open scientific ecosystem roots itself in "open access" initiatives. Although the term is retrospectively applied to earlier initiatives, it was first defined at a conference in Budapest in 2002. Below, I present key events and initiatives that have shaped Open Science as we know it today.

1. Open Access Journals

   One tool for scientific communication is peer-reviewed journals. The emergence of the first fully open-access scientific journals dates back to the end of the 20th century. The development of the internet and digital technologies since the 1970s enabled the online sharing of scientific results. "*Flora Online*" was one of the first journals to appear in electronic form in 1987. However, the real breakthrough came with the "*Journal of High Energy Physics*" (JHEP), launched in 1997, providing full open access to all its articles.[ii] The first publisher exclusively releasing fully open journals was BMC (1999).

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2. Preprint Servers and Open Repositories Serving the Dissemination of Scientific Information (arXiv 1991)

   In 1991, the first preprint server, known as arXiv, was launched, revolutionizing the dissemination of physical research. This platform allowed researchers to share their manuscripts with anyone online in advance of publishing, thereby accelerating the flow of scientific information. ArXiv not only facilitated accessibility to information but also provided an opportunity for immediate feedback and scientific dialogue. This significant milestone paved the way for open science, where results are freely accessible and shareable within the scientific community.

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3. Budapest Open Access Initiative (BOAI, 2002), Birth of the Open Access Concept

The Budapest Open Access Initiative was an initiative that played a key role in defining the principles of open access. Its goal was to promote widespread accessibility of the results of scientific research, thereby laying the foundations for open science. The initiative concluded with a manifesto, and the principles articulated in it determined the direction that open access would follow.

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4. Berlin Declaration (2003):

The term "open access" as used today emerged in the document *Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities* (2003). The Berlin Declaration already emphasized the importance of the free accessibility of research results, highlighting that scientific knowledge should be widely accessible and usable. Consequently, the declaration contributed to the global spread and acceptance of open access within the scientific community.

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5. Open Data and FAIR Principles:

In our brief historical overview, let me mention another milestone. The development of open data and FAIR principles has been shaped by various events and initiatives.

- Important steps towards open data and FAIR data management include the sharing of computer code and software, as seen in the open-source movement.
- Internal pressure within the scientific community also contributed to the proliferation of data sharing and open data. More and more researchers recognized the importance of transparency and the reproducibility of results.
- Economic considerations are also significant. Well-documented research data, experiments, and data collections do not need to be replicated. These and other factors led to the formulation of the FAIR data management principles in the article "The FAIR Guiding Principles for scientific data management and stewardship," published in 2016 (Mark D. Wilkinson). This represents a significant milestone in the development of open scientific practices.

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The Fundamental Pillars of the Open Science Ecosystem

In shaping Open Science, every stakeholder in scientific work played their own role. Not only scientists but also science funding bodies, research institutions, publishers, and decision-making bodies at various levels, such as governments or UNESCO.[iii]

In Hungary, the NKFIH (National Research, Development and Innovation Office) published its *Position Paper*[iv] on open science on October 15, 2021. Additionally, administrative steps were taken by including the research data management plan as a mandatory attachment in several research grant applications, alongside the previously introduced open access publishing. The statement interprets the practice of open science as an ecosystem with 8 fundamental pillars. These pillars address various actors in the research ecosystem, including researchers, research funders, and decision-makers.

1. open access to research outputs
2. FAIR(1) and CARE(2) research data management
3. research integrity
4. next generation metrics in research assessment
5. new types of rewards and initiatives
6. international cooperation networks
7. Citizen Science
8. education and skills

I won't delve into the first two pillars as they will be covered in detail in subsequent presentations.

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Research Integrity and Scientific Autonomy, "fundamental pillars of open science based on the universal principles of science," essentially do not differ from the „non-open scientific" perspective. However, it is necessary to emphasize their importance here as well. This includes "diversity and equality, excellence, integrity, researcher curiosity, responsibility, ethical behavior, and reflexive thinking." (NKFIH, Statement)

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The essence of developing a new generation of science evaluation systems is to incorporate qualitative aspects alongside quantitative measurements (e.g., citation counts and the Hirsch index). ELTE is a member of the CoARA initiative, a European collaboration.[v] This pillar can be realized at institutional levels in performance evaluations or human resource selection and at the research funding level in grant reviews and awards.

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In creating a new type of incentive system, research career evaluation systems must fully acknowledge open scientific activities. The open scientific ecosystem provides opportunities and encourages participants in research to seek solutions to existing problems through inter- and multidisciplinary collaborations, fostering innovation in research and development. International collaborations such as RDA[vi], EOSC, cOAlition S[vii], and OpenAIRE[viii] have been established to facilitate the practical implementation of open science.

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Citizen Science, or as it is commonly known in Hungary, Community Science, is nothing more than the active participation of non-professional researchers in research. Activities range from small projects of interest groups to large international projects, often led and facilitated by professional scientists and research institutions. Citizen science can encompass a wide range of activities, and the availability of smartphones and other devices opens up new opportunities for involving members of society in research. (LERU)[ix]

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Education and Training.

This pillar focuses on determining the training needs of researchers and addressing the gaps in knowledge and skills necessary for practicing open science. Every researcher should have access to educational and skill-building programs at all levels that support their work and ongoing learning (life-long learning).

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In addition to Open Science, it's important to emphasize Open Educational Resources (OER). MIT has been a pioneer in this field, launching an initiative in 1999 to make all MIT courses openly accessible, starting with 32 courses in 2002. Today, more than 2500 courses are available.

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Open Science is an effective tool for promoting the principles and objectives of several Sustainable Development Goals (SDGs). By fostering openness, collaboration, and inclusivity in scientific communities, Open Science contributes to addressing complex challenges and advancing global efforts towards sustainable development.

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After this brief introduction, I have nothing left but to wish you continued success in studying the series that presents the elements of open scientific work. I hope it contributes to your scientific progress.

Thank you for your attention!

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[i] https://www.youtube.com/watch?v=I3Wkvx_ZaFo
[ii] https://webzine.web.cern.ch/1/papers/3/
[iii] https://www.unesco.org/en/open-science/about; https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en;
[iv] https://nkfih.gov.hu/nyilt-tudomany
[v] https://coara.eu/
[vi] https://www.rd-alliance.org/
[vii] https://eosc-portal.eu/
[viii] https://www.openaire.eu/
[ix] https://www.leru.org/files/Citizen-Science-at-Universities-Trends-Guidelines-and-Recommendations-Full-paper.pdf