

## **Augmented Cooperation In Education And Training In Nuclear And Radiochemistry - The A-CINCH Project**

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#### **ABSTRACT**

The A-CINCH project addresses a series of problems generated by attrition combined with decrease of interest from the new generations in the field of nuclear and radiochemistry (NRC). During several nuclear radiochemistry dedicated projects it was observed that many EU (European Union) countries have rather a limited number of specialists in radiochemistry. In the same time lack of new people to replace the retiring specialists or necessary to fill in the existing gaps was more and more observed.

As a consequence, one of the purposes of the project was to develop actions that should attract secondary, high school students and teachers to the nuclear and radiochemistry and to develop for them a new concept: “Learn through Play”.

To address these new target groups and to attract efficiently their attention, advanced educational techniques such as state-of-the-art 3D virtual reality NRC laboratory, Massive Open Online Courses, RoboLab distance operated robotic experiments, Interactive Screen Experiments, NucWik database of teaching materials, or Flipped Classroom, are being introduced into the NRC education. Nuclear awareness will be further increased by the High School Teaching Package, Summer Schools for high school students, Teach the Teacher package and others.

Both new tools and existing ones, developed during the previous projects of the series, will be linked in A-CINCH HUB – a user-friendly and easy-to-navigate single point of access. The aim is to increase the number of students and trainees in the field of nuclear and radiochemistry.

The main motivation behind this project is that: expertise in nuclear and radiochemistry is of strategic relevance in the nuclear energy sector and in many other vital applications. The need for radiochemistry expertise will even increase as the focus shifts from safe nuclear power plant operation to decontamination and decommissioning, waste management and environmental monitoring. Applications for NRC are even broader when moving to other fields, they range from life sciences - radiopharmaceuticals, radiological diagnostics and therapy - through dating in geology and archaeology, (nuclear) forensics and safeguards operations, to radiation protection and radioecology.

## 1 INTRODUCTION

The A-CINCH project or Augmented Cooperation in education and training In Nuclear and radioCHemistry it is the latest project from a series of nuclear and radiochemistry dedicated CINCH projects.

The 1<sup>st</sup> project was CINCH (also referred to as CINCH-I) then came CINCH-II and MEET-CINCH. Information about these past projects can be found in [1].

The CINCH projects series have been aiming at the Coordination of education and training In Nuclear CHemistry and started by receiving support from the EURATOM FP7 and H2020 programs.

This action was taken to meet the deficits in terms of personnel for nuclear and radiochemistry field.

Several notable outputs were provided as a follow up of previous CINCH projects such as the first use of a Virtual Reality Laboratory (VR-Lab) that has been designed to deliver courses to members of regulatory bodies. This new methodology of teaching received a very positive feedback. Based on the very encouraging results of the VR-Lab, the innovative concept for A-CINCH project is “Using VR to enhance NRC teaching”.

The goal of the present project, A-CINCH is to take actions to address the loss of the young generation’s interest for nuclear knowledge in general and for nuclear and radiochemistry in particular. The project intends to rely on the “learn through play” concept with the aim of attracting high school students to the nuclear and radiochemistry field.

The project's targeted age group remains wider though, including older students, teachers and even professionals.

Another important objective of the A-CINCH project is the development of the so-called A-CINCH Hub [2]. This object will wrap up all previous CINCH results into a single user-friendly and easy to-navigate interface, complete it with newly developed courses, and implement highly innovative Virtual Lab based on the involvement of augmented reality and gamification applied on nuclear and radiochemistry education with the overall goal to increase number of students and trainees.

The concept of the Hub is presented in Figure 1 below. The whole concept focuses on the virtual lab which together with a special series of tools like:

- Massive Open Online Courses (MOOC);
- Nuclear and Radiochemistry Teaching Material Wiki (NucWik);
- Learning Management System platform (MOODLE);
- Robotic Remote-Controlled Experiments (RoboLabs)

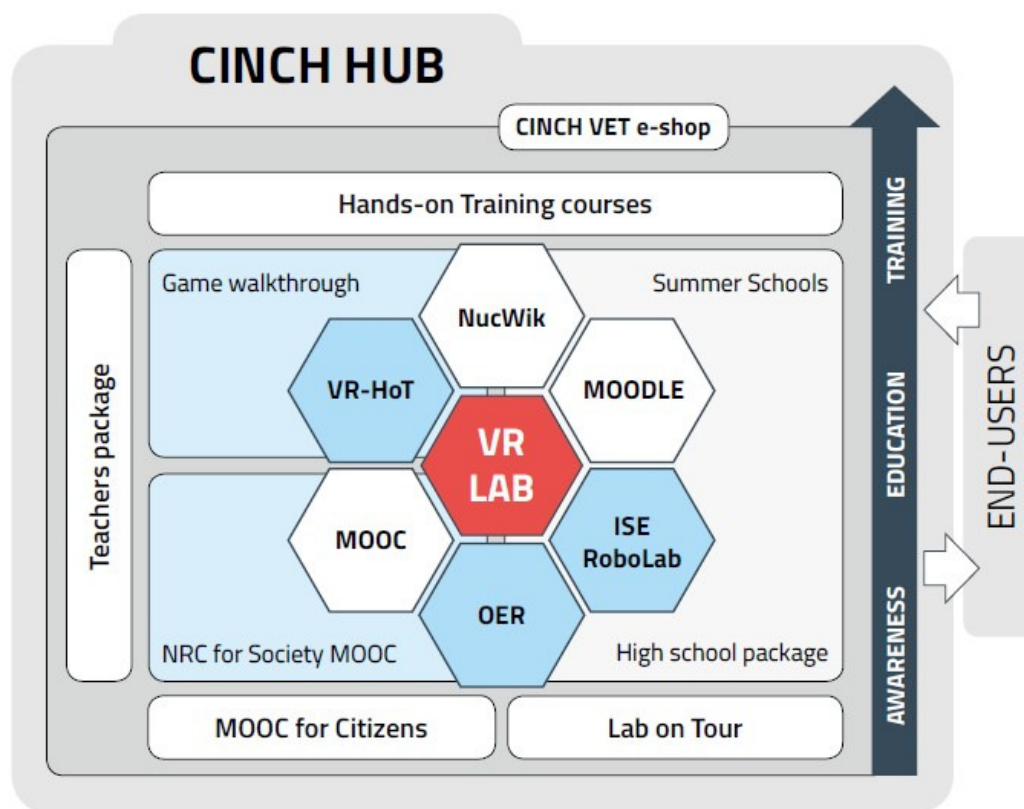
combined with a series of innovative methodologies:

- Virtual reality teaching;
- Online teaching;
- Virtual laboratories;
- Hands on Training;

- Gamification.

produce relevant content for teachers and students that can be used for:

- Summer schools;
- Class materials;
- Materials for introducing the nuclear radiochemistry to regular citizens;
- Materials for upgrading knowledge skills and competences of employees.



**Figure 1.** CINCH Hub description. It is supposed to embed all the educational tools produced as project outputs both in A-CINCH and in the previous projects in the CINCH series. In white hexagons, activities which are a follow up of previous projects in the series, in light blue hexagons (and red) activities which are a novelty and will be developed under A-CINCH.

## 2 PROJECT STRUCTURE

The project is articulated in 7 Working Packages (WP) and their outputs are intended to contribute to three pillars, considered the main axis of the project [3]:

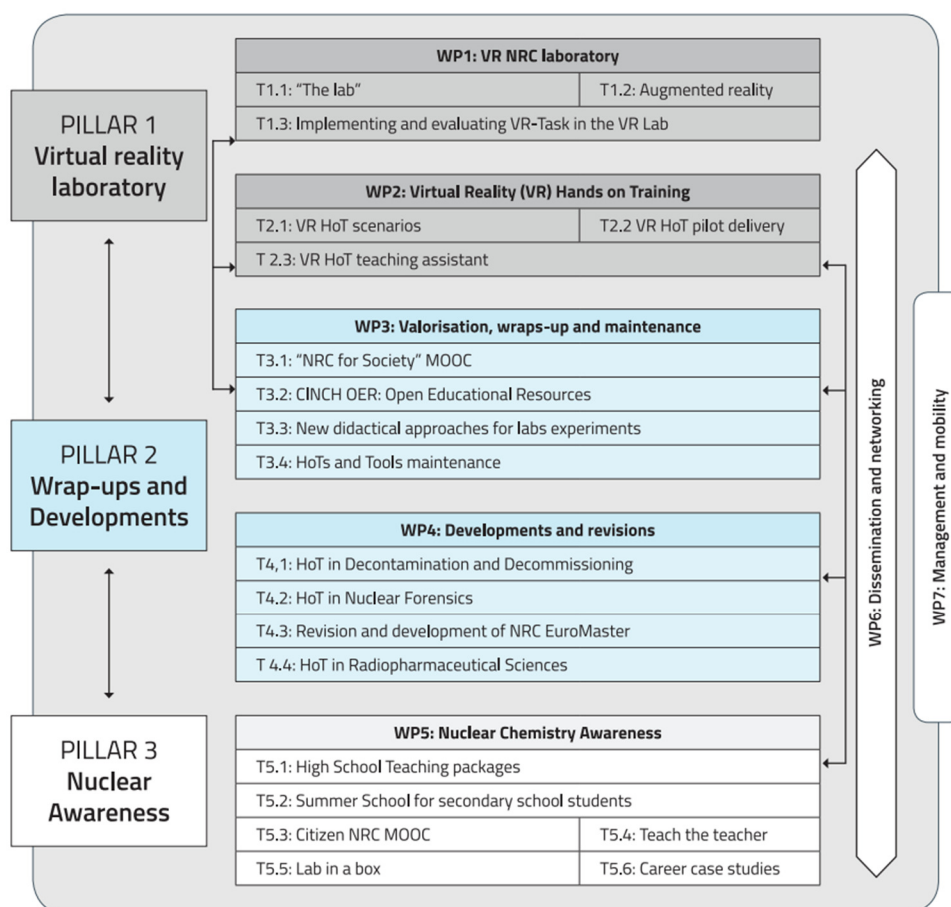
1. The creation of a state-of-the-art Virtual Reality Laboratory;
2. Ensure the sustainability of the existing educational tools and the developments of new ones;
3. Raise awareness towards the nuclear field, with a focus on radiochemistry.

The pillars will be supported by two cross-cutting activities:

- Dissemination and Networking;
- Mobility and Management.

The structure of the project is presented in the schematics below and describes very briefly how these three pillars are addressed by the activities and the outputs of the project, translated into Work Packages. As pillar 1 is more dedicated to experts or employees who need (re)training,

this is addressed by the first two work packages in which special actions in form of laboratories and hands on training were conceived. Pillar no.2 is focusing on students of different ages and actions in this regard are created. The last pillar is dedicated to creating a set of outputs aimed at attracting new generations to the field of nuclear radiochemistry.



**Figure 2.** A-CINCH project structure, articulated in Working Packages

## 2.1 WP1 - Virtual reality NRC laboratory

WP1 is dedicated to the development of a 3D environment for Nuclear and Radio Chemistry (NRC) laboratories. The outputs will consist in a platform where to implement Virtual Reality (VR) Hands on Training (HoT) scenarios.

The VR-Lab represents the main innovative aspect of the project, which links different elements of the project to each other. It will give the user a broad (virtual) insight into a radiochemical laboratory work and the virtual environment will introduce various working tasks in a playful way.

The concept of VR-Lab will present several rooms and each one of them will be designed following the requirements and the technical standards for working as a radiochemist. The users will also be able to interact with some objects in order to simulate working in a laboratory.

The goal is to maximize the educative effect by integrating some CINCH learning tools granting access to teaching material.

The VR-Lab will utilize already existing or just updated materials and tools together with newly developed A-CINCH results and provide them to the target groups in highly innovative and attractive way.

## 2.2 WP2 - Virtual Reality (VR) Hands on Training (HoT)

The main objective of WP2 is to develop scenarios and screenplays to be used in HoTs. These hands-on trainings will be applied to different areas and will deal with different aspects of radiochemistry.

In parallel, the Project will introduce a virtual teaching assistant in the form of an interactive game walkthrough for the VR HoT users. This virtual assistant is intended to provide help on how to complete some specific tasks and also provide link to NRC fundamentals and additional resources. This will be accomplished by taking advantage of and reusing already existing resources and teaching materials produced within previous CINCH projects, in particular NucWik, video lectures and other manuals and materials.

The introduction of VR HoTs will allow to create an educational platform and will provide a learning tool which could be used as “teasers” for:

- high school students to attract their attention,
- for the general public to create awareness,

as a base for flipped classroom and, in principle, as a pre-requisite to be enrolled in the real HoT that will be held during the A-CINCH project.

Last but not least, the gaming experience associated to the VR HoTs will allow to better deliver the content to the young generation. It is reasonable to expect that this will be a tool to enhance their learning outcome and possible light up their interest for the radiochemistry domain.

## 2.3 WP3 - Valorisation, wrap-ups and maintenance

WP3 will focus its effort in valorizing the knowledge that has already been developed along the previous projects in the CINCH series.

Specifically, it will focus on improving the MOOC experience among students, promoting new pedagogical approaches among teachers and making new material available as Open Educational Resources (OER) and practices.

Within the series of CINCH-projects, many courses and teaching materials have been delivered. However, some of them are not easy to be used by those who are not members of the partnership. Therefore, some effort will be dedicated to designing the way to spread the created knowledge, and to releasing and sharing the teaching and learning materials as OER. At the same time, this activity is expected to result in increased awareness of NRC.

NucWik will be the main platform dedicated to publishing and sharing the OER materials.

CINCH OER will be:

- free resources published under the Creative Commons Licence,
- digital, accessible to anyone, anytime via the internet,
- high quality university level educational materials,
- organized as courses,
- not requiring any registration
- not degree-granting or certificate-granting.

This WP aims as well to ensure access to this material in the future (even after the project ends). The MOOC titled “Nuclear-Radiochemistry for Society” will be delivered in parts, several editions animated by webinars and forum discussions. It will be kept continuously up to date since there will be feedback provided by the users.

Moreover, there will be the design of selected usage patterns and the production of related toolkits to facilitate the use of the MOOC “Nuclear-Radiochemistry for Society” in different context.

There will also be the design of a model to release and use available CINCH materials and resources as Open Educational Resources. The choice of what material is released via this model will be made on the basis of collected data and gap analysis performed about the future needs of the teachers.

There will be the guarantee that all the produced material will remain available.

The interaction with teachers by means of dedicated teacher training is also planned. This will be an important opportunity to share experiences in difficulties in teaching and to be aware of different options to engage students by means of new methodological choices and pedagogical approaches.

## **2.4 WP4 – Developments and revisions**

The main goal for WP4 is the development of new hands-on type training courses.

In the previous CINCH-series projects, several courses were fully developed and tested; based on the feedback from participants and related end-users, the course template was optimised and is available for additional courses. The planned new HoT courses aim at covering the areas that are now receiving high attention in the European scientific community.

The new Hands-on Training courses are:

1. “HoT on Decontamination and Decommissioning (D&D)”

University curricula in D&D are still rare or just being designed, and the nature of D&D requires practical experience and ability to apply a wide spectrum of knowledge in a flexible way. For such purpose, basic hands-on training is essential.

2. “HoT in Nuclear Forensics”

Nuclear forensics is a part of forensic sciences and as such covers a broad scope of disciplines (e.g. chemistry, physics, biology, social sciences, etc.) used for evidence analysis and many other disciplines for the evidence evaluation (e.g. in crime investigations).

However, similar to all forensic sciences, crucial attention to sampling, sample treatment, measurement, and evaluation of the measured results is required to maintain the initial information.

3. “HoT in Radiopharmaceutical Sciences (RS)”.

This is a multidisciplinary field that involves the contribution of chemistry, radiochemistry, pharmaceutical sciences and biology to assure the development of new radiopharmaceuticals and the safety and efficacy of the radiopharmaceuticals in clinical use.

WP4 will also review and further develop the NRC EuroMaster quality label, developed in CINCH and CINCH-II as a label for universities that meet the “NRC Minimum Requirements” for teaching nuclear and radiochemistry developed in CINCH-II and approved by the Division of Nuclear and Radiochemistry of the EuChemS (DNRC).

## **2.5 WP 5 – Nuclear chemistry awareness**

WP5 will develop a distributable and sustainable toolkit of standalone resources to promote and increase awareness of the field of nuclear and radiochemistry. The overall objective is to make the field attractive to the younger generation and motivate school students to pursue a career in nuclear chemistry in industry or academia. WP5 also targets the general public and high school teachers to make them aware of the importance of NRC to society. This will equip parents and teachers with insight to inform their children or students about careers in this field. Although each task is a standalone resource (or tool), they have been designed so that they can be utilised together to enhance their effectiveness.

These resources are planned to be:

- A polished, distributable teaching package for high school teachers across the EU.
- A Summer school for Secondary / High School Students will be developed and will be piloted in the UK and Cyprus
- A MOOC for citizens will be developed adapting the scientific level to a new general target, to bring innovation to nuclear education at a basic level
- The “Teach the Teachers” will provide teachers with an introduction to the role of NRC in society and the range of careers available.
- An outreach toolkit called “Lab-in-a-Box” will be developed and it will allow its users to select activities/materials appropriate to the audience of the festival/fair being targeted.
- A series of case studies will be produced that highlight where and how nuclear/radiochemists have made an impact stressing the benefits of having trained nuclear/radiochemists.

## **2.6 WP6 – Dissemination & Networking**

WP6 main objective is to provide support in the dissemination and implementation of project results to ensure that the information about the project and its results will be delivered among the nuclear community, all relevant target groups and end-users.

At the same time, WP6 should assure the long-term sustainability and exploitation of the CINCH-series of projects. Among other actions, setting up and maintaining the project website. Promotion of events or participation in networking events at the national and international levels complete the list of tasks. The work of this WP runs horizontally throughout the project duration in order to drive the previous as well as the newly elaborated results towards their exploitation and the long-term sustainability.

## **2.7 WP7 - Mobility & Management**

WP 7 is the second transversal activity of the project. Its objective is to provide an efficient management of the A-CINCH activities including overall project steering.

Furthermore, WP7 will assure international exchange of knowledge and practical experience among students, teachers for secondary, higher and vocational education, end-users, and lecturers through the mobility scheme.

## **3 CURRENT PROJECT STATUS AND VISION**

The project is currently in its first year of implementation. It is scheduled to end in September 2023 after 36 months of implementation.

## **4 CONCLUSIONS**

The A-CINCH project is the latest in the series of CINCH projects. It mainly addresses the challenge of (re)awakening the interest of young generations for nuclear knowledge involving them by the “learn through play” concept. All teaching tools, existing ones from previous projects and newly developed ones will be grouped in the CINCH Hub to contribute increasing the number of students and trainees in the field of nuclear and radiochemistry.

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