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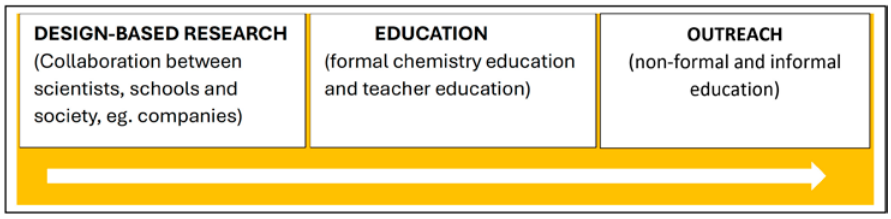
INSPIRING THE MAKERS OF THE FUTURE IN SCIENCE

THROUGH COLLABORATION WITH SCIENTISTS, SCIENCE EDUCATORS, SCHOOLS AND SOCIETY WITHIN LUMALAB GADOLIN

MAIJA AKSELA, JOHANNES PERNAA, OUTI HAATAINEN, REIJA PESONEN AND EMMI VUORIO

Chemistry plays a pivotal role in shaping a sustainable future. In this dynamic field, understanding the nature of science—including novel scientific facts in chemistry, processes, thinking, and innovations—is essential for future generations and their educators. LUMAlab Gadolin, formerly ChemistryLab Gadolin, at the Department of Chemistry, is committed to promoting scientific literacy through innovative activities in modern chemistry. By fostering collaboration among scientists, science educators, schools, and the broader community, LUMAlab Gadolin offers inspiring activities and role models, engaging the community meaningfully in Finland and abroad. Using educational design-based research as a framework, it creates innovative models and solutions for chemistry and teacher education, disseminating them through formal, non-formal, and informal education. This article explores the strategic initiatives of LUMAlab Gadolin for 2025-2028 and some activities, emphasizing its dedication to modern chemistry, sustainability, technological advancement, and community engagement.

Established as the first university-based LUMAlab in Finland, Gadolin has evolved from "ChemistryLab Gadolin" (2008-2024)[1,2] into a hub for inspiring science education both in Finland and abroad. It serves as a forum for collaborative design-based research, innovative education, and outreach, focusing on evidence-based, student-centered models and solutions. One of its main guiding principles is ensuring relevance at personal, vocational, and societal levels.



LUMAlab Gadolin is a collaborative hub for design-based research, education and outreach in science education. The research topics that are developed based on design research are disseminated through formal, non-formal, and informal education to everyone. LUMAlab Gadolin supports the aims of the Finnish national LUMA (STEM) strategy and its action plan[3] by collaborating closely with the national LUMA Centre Finland network, which includes 11 universities and 13 centers,[4] with the first established at the University of Helsinki in 2003.[5]

Inspiring the Makers of the Future

At the heart of LUMAlab Gadolin's mission is the goal to inspire makers of the future and educate talent teachers through engaging, research-based, and community-oriented science education. Talent teachers are the main agents for a sustainable future. LUMAlab is closely integrated into both evidence-based, research-oriented pre-service and in-service training programs and their research.[6-9]

By integrating student-centered activities into its programs, LUMAlab Gadolin ensures that students are not only learners but also a central part of the innovation process. These activities range from designing learning materials to instructing pupils during school visits, providing hands-on experiences that motivate students to learn chemistry and pursue careers in chemistry.

Collaboration is the Key to Success

Collaboration is a cornerstone of LUMAlab Gadolin's strategy. By fostering partnerships with universities, schools, and companies, LUMAlab Gadolin creates a network of support that enhances the educational experience for all participants. This collaborative approach not only enriches the learning environment but also drives innovation and ensures that the programs remain relevant and impactful. The research-based activities co-designed together are both national and international, emphasizing the importance of working together to achieve greater success. Together we are more!



International students also visit LUMAlab Gadolin for hands-on activities and learning chemistry.

Strategic Initiatives for 2025-2028

LUMAlab Gadolin's strategic plan for 2025-2028 focuses on several key areas:

1. **Governance and Leadership:** A governance model ensures clear roles and responsibilities. Regular meetings and an annual planning day facilitate effective communication and planning within the team and its collaborators, including scientists, science educators, schools, and society. University students also have a crucial role as actors.
2. **Research and Innovation:** Emphasizing design-based research, LUMAlab Gadolin collaborates with the Chemistry Teacher Education Unit to explore sustainable and technological advancements in chemistry education. The research topics that are developed based on design research are disseminated to everyone through formal, non-formal, and informal education. This includes integrating modern technology, such as AI, into educational practices.
3. **Teacher Education:** Integrating evidence-based research into pre-service and in-service training programs, LUMAlab Gadolin supports continuous learning for teachers. Programs like Experimental Clinics, the LUMA-AI forum, ½-VESO days, and Chemistry Education Days, online courses/happenings (e.g., StarT LUMA, International Teachers Climate Change forum) and international projects promote scientific literacy and modern chemistry education. Most pre-service courses include a task or research project within LUMAlab Gadolin.
4. **Community Outreach:** Engaging the community through outreach activities developed through design-based research, LUMAlab Gadolin promotes science education for children, youth, teachers, families, and the general public. Activities include school visits, science clubs, and camps, as well as online platforms like Virtual Gadolin with online courses.
5. **Resource Management:** Leveraging funding from various sources, including universities, national networks, sponsors,[12] and EU foundations, to support its initiatives. New partners are always welcome to join in these efforts.

The Need for Modern Chemistry and Role Models

LUMAlab Gadolin addresses the need for modern chemistry education by offering students opportunities to engage in cutting-edge research and innovations through various collaborative efforts. By partnering with scientists and industry leaders, students gain exposure to the latest advancements in chemistry and understand the significance of their contributions to the field. These collaborations provide youth with inspiring role models who demonstrate the real-world applications of chemistry and the impact of innovative research.

A variety of relevant activities are co-designed with student agency to achieve this purpose. Finnish research and innovations are a primary focus at LUMAlab Gadolin. The main themes—materials, energy, health, and environment—are central to modern research at the Department of Chemistry. For example, the LUMA Stars program, co-designed with youth, will be one of the novel activities introduced in the near future.

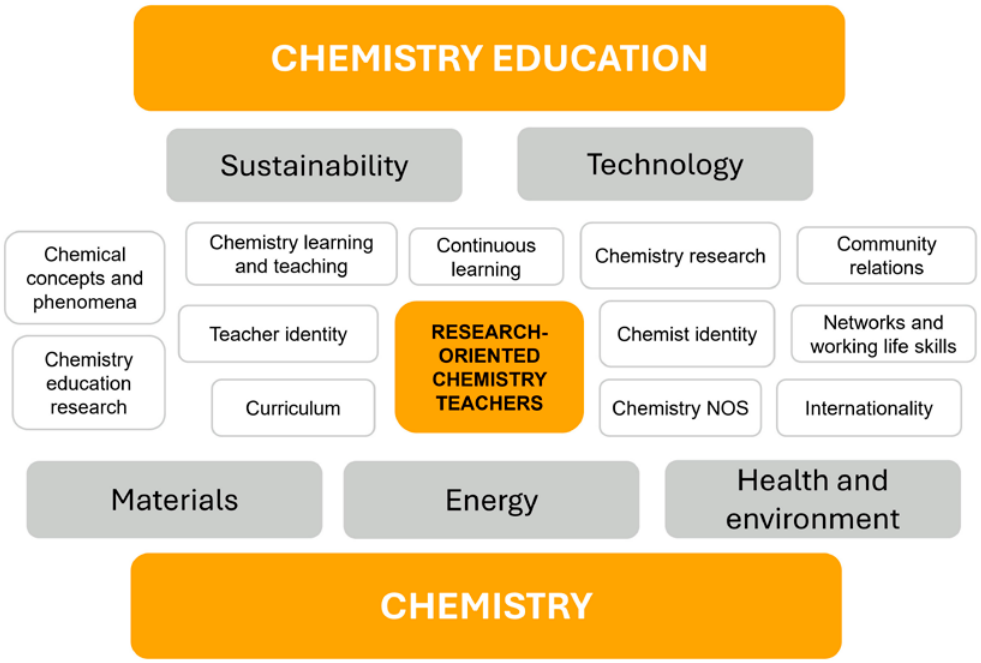


Figure 2: Our model and focus for LUMAlab Gadolin as part of national and LUMA activities at the University of Helsinki. It is closely integrated into both evidence-based, research-oriented pre-service and in-service training programs.[6-9] The themes—materials, energy, health, and environment—are the main focuses in modern research at the Department of Chemistry.

Collaborative Design-Based Research

LUMAlab Gadolin employs collaborative design-based research as its framework for developing novel models and solutions (see Figure 3). This approach integrates sustainability thinking and modern technology (e.g., AI) into modern chemistry and its innovations (see Figure 2). Starting from identified needs, it connects contemporary research in chemistry with educational goals and activities in partnership with scientists, science educators, schools, companies, and other societal stakeholders.

Pilot models can be tested with school students, teachers, or student teachers. Data is collected through various formal, non-formal, and informal educational activities, following iterative cycles in design-based research. The outcomes, including theses, learning tasks in material banks, papers, and publications, are utilized in teacher education. This model represents a novel approach to teacher education, where all participants learn collaboratively from each other.

Examples of Student-Centered Activities

1. **School Visits and Workshops:** LUMAlab Gadolin develops different models for visits to schools where students can participate in interactive workshops. The research topics that are developed based on design research are disseminated to everyone through formal, non-formal, and informal education. These sessions often include demonstrations, hands-on experiments, and discussions with scientists on current topics in chemistry. For example, the LUMA Start program is a key focus for the near future. University students are guiding them, and it is also an integral part of teacher education.[9]
2. **Virtual Gadolin:** An innovative online platform that offers laboratory experiences or meeting scientists or engineers as role models. Students can conduct experiments and explore chemical phenomena in a school environment, making advanced chemistry accessible to a wider audience. A material bank with novel activities serves teachers.
3. **Science Clubs and Camps:** LUMAlab Gadolin hosts science clubs and camps during school afternoons and holidays, where students can immerse themselves in chemistry through a variety of activities, including experiments, field trips, and guest lectures from scientists and industry professionals. For some activities, family members are also welcome. Clubs and camps can be integrated into teacher education.
4. **Online courses:** For example, the MOOC online courses, such as 'Chemistry Now and in the Future,' are also included.

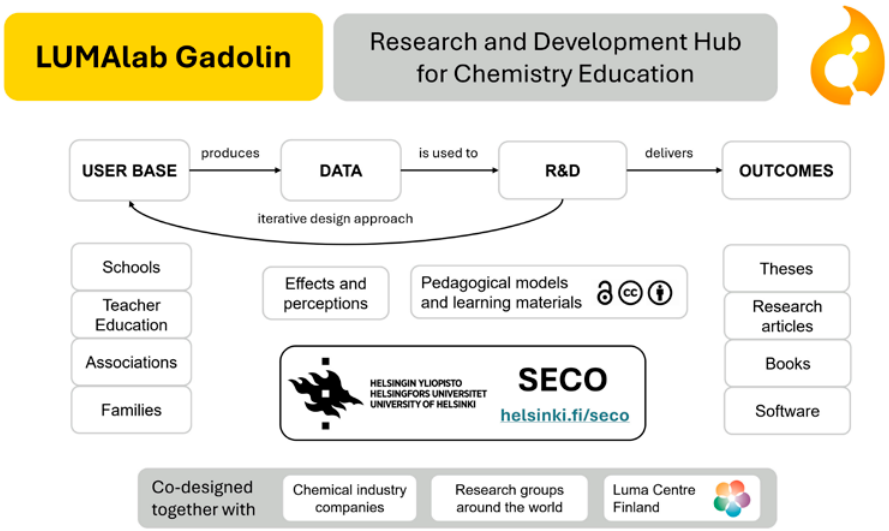


Figure 3: Collaborative and research-based action through LUMAlab Gadolin using design-based research as a framework.

Conclusion

LUMAlab Gadolin strives to lead in modern chemistry education globally by inspiring future innovators through student-centered, research-based activities. It provides role models and fosters collaboration among scientists, educators, schools, and society. Collaborative design-based research is viewed as the key to success. By advancing relevant teacher education and research, LUMAlab Gadolin ensures that the next generation is well prepared to address the challenges of a sustainable future. Through collective efforts, we can achieve greater success and instill hope for a brighter, more sustainable world.

By introducing young people to current research in an inspiring way, it might increase their interest in chemistry.



References

[1]10th anniversary book: ChemistryLab Gadolin – 10 year anniversary book – The Unit of Chemistry Teacher Education
[2] 15h anniversary book: ChemistryLab Gadolin: 15 years of inspiring innovations for science education - University of Helsinki
[3]Finnish national LUMA (STEM) strategy and action plan: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/164953/OKM_2023_22.pdf?sequence=1
[4] Aksela, M., Lundell, J., & Ikävalko, T. (Eds.) (2020). *LUMA Finland -Together we are more.* LUMA Centre Finland. LUMA Finland -Together we are more - University of Helsinki
[5] Aksela, M., Oikkonen, J., & Halonen, J. (Eds.) (2018). Collaborative Science Education at the University of Helsinki since 2003: *New Solutions and Pedagogical Innovations for Teaching from Early Childhood to Universities.*
Unigrafia. https://www.helsinki.fi/sites/default/files/atoms/files/isbn-978-951-51-4089-0.pdf
[6] Aksela, M. K. (2010). Evidence-based teacher education: becoming a lifelong research-oriented chemistry teacher? *Chemistry Education Research and Practice*, 11(2), 84-91. https://doi.org/10.1039/C005350N
[7] Pernaa, J., Haatainen O. & Aksela, M. (2025). Evidence-based Research-oriented Chemistry Teacher Education (submitted): Evidence-Based Research-Oriented Chemistry Teacher Education - University of Helsinki
[8]The Unit of Chemistry Teacher Education, Department of Chemistry, University of Helsinki and its research: The Unit of Chemistry Teacher Education – Department of Chemistry
[9] Haatainen, O., Pernaa, J., Aksela, M., Pesonen, R. M., & Halonen, J. (2024). Supporting the Teacher Identity of Pre-Service Science Teachers through Working at a Non-Formal STEM Learning Laboratory. *Education Sciences*, 14(6), Article 649. https://doi.org/10.3390/educsci14060649
[10]Pernaa, J., & Aksela, M. (2013). Model-Based Design Research: A Practical Method for Educational Innovations. *Advances in Business-Related Scientific Research Journal*, 4(1), 71–83.
[11]Aksela, M. (2019). Towards student-centred solutions and pedagogical innovations in science education through co-design approach within design-based research. *LUMAT: International Journal on Math, Science and Technology Education*, 7(3), 113–139. https://doi.org/10.31129/LUMAT.7.3.421
[12] The companies collaborating with LUMAlab Gadolin: ChemistryLab Gadolin | Science education and Academic Outreach | University of Helsinki