# Emmanuel Echeverri-Jimenez, Ph.D.

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## Professional Profile

Ph.D. in Chemistry Education, Masters in Organic Synthesis and Computational Chemistry. Proficient educator expert in the development of experiments and activities to teach, communicate and divulgate Chemistry. Vast teaching experience ranging from elementary school to graduate-level chemistry. Operative knowledge in theoretical-computational protocols and asymmetric catalysis. Certified virtual- and augmented reality developer. Fast-learning programmer that has built open-source APIs.

## Academic Formation

**Doctor of Philosophy – Chemistry** (North Carolina State University, USA) **Jan. 2018 – Aug. 2022**
Director: Dr. Maria Teresa Oliver-Hoyo
Thesis: Familiar-shape framework to explore visual-spatial skills and representational competence in organic chemistry at the graduate level, using a novel virtual-reality learning environment.

**Masters in Science – Chemistry** (Universidad de Los Andes, Colombia) **Jan. 2013 – Dec. 2014**
Director: Dr. Diego Alexander Gamba Sánchez
Thesis: Camphor derivatives and their use as catalysts in an enantioselective protonation reaction.

**Bachelor in Science – Chemistry** (Universidad de Los Andes, Colombia) **Jan. 2009 – Dec. 2012**
Director: Dr. Diego Alexander Gamba Sánchez
Thesis: Chemical modification of natural compounds and preliminary essays as chiral protonating agents.

## Research Experience

**Balabanoff Chemistry Education Research Group** – University of Louisville **Feb. 2023 – present**
Supervised by Dr. Morgan Balabanoff

- Explore students' epistemological knowledge in the context of atomic models.
- Design, conduct, and analyze qualitative interviews.
- Publish and present research findings at conferences and in refereed journals
- Assist in the development of research proposals to secure extramural funding.
- Mentor undergraduate researchers.
- Design, build and manage research group website

**Oliver-Hoyo Chemistry Education Research Group** – North Carolina State University **Jan. 2018 – Aug. 2022**
Directed by Dr. Maria Teresa Oliver-Hoyo

- Compiled, interconnected, and operationalized multiple theoretical and pedagogical frameworks to integrate Advanced Organic Chemistry content with a Virtual Reality Learning Environment.
- Developed and carried out structured & semi-structured interviews as part of a qualitative study about the comparison of visual-spatial skills, challenges and strategies between undergraduate- and graduate students.
- Designed, developed, assessed, and implemented a Virtual Reality Learning Environment to study cycloaddition reactions.
- Collaborated in the implementation of inter-rated reliability protocols for various qualitative studies.
- Contributed to the advancement of Chemistry Education Research by regularly presenting my research results in the form of posters and talks in multiple conferences.
- Created an open-source application programming interface using python to convert computational calculations into 3D models for their use in illustrations, 3D printing, and extended reality applications.

**Computational and Bio-Organic Chemistry Group** – Universidad de Los Andes, Colombia **Jan. 2015 – Dec. 2016**
Directed by Dr. Gian Pietro Miscione

- Operated high-performing computational clusters for the quantum-mechanic simulations of chemical reactions in gas phase and in solution.
- Implemented intrinsic reactive coordinate protocols in Gaussian to explore potential energy surfaces for pyrazole reactions.
- Applied simulated annealing molecular dynamics protocols for conformational analyses, and geometry optimizations.
- Utilized the ONIOM method for optimization-frequency calculations in systems with more than 40 atoms.

**Organic Synthesis, Bio- and Organocatalysis Lab.** – Universidad de Los Andes, Colombia **Jan. 2012 – Dec. 2014**
Directed Dr. Diego Gamba Sánchez

- Designed, and autonomously implemented synthetic routes, retrosynthetic analyses, and solutions for laboratory problems.
- Synthesized, isolated, purified, and characterized natural products' derivatives to use as chiral protonating agents.
- Implemented the SIMPLEX method for the enantiomeric resolution in HPLC for optically enriched products.
- Developed enantiomeric excess studies for enantioselective protonations in catalytic scales.
- Monitored the concentration of super-bases such as LDA, LiHMDS, KHMDS, and n-BuLi for the whole the laboratory.
- Dried organic solvents such as DCM, THF, MeCN, AcOEt, among others for their use in water-free procedures.
- Implemented inert atmosphere and ultra-low temperature (from -100°C to -78°C) procedures for the kinetic control of aldol condensation and Mannich reactions.

## Teaching Experience

**Teaching Assistant –** North Carolina State University, USA **Jan. 2018 – Aug. 2022**

- Prepared assignments and taught lectures for Organic Chemistry Labs I & II for undergraduate chemistry majors, and Advanced Organic Chemistry for graduate students. Labs included: microscale synthesis, verification laboratories for carbonyl compound reactions, H-NMR, FTIR, GC, extraction & purification methods
- Developed and standardized the rubric to assess students' lab reports for Organic Chemistry I & II, which were implemented by other teaching assistants in their classes.
- Supported NC State's distance-education efforts by teaching laboratory procedures while being video-recorded. These videos became part of the Chemistry Department's Virtual Reality Laboratories repository.
- Developed and implemented a series of demonstrative experiments with the purpose of promoting visibility and representations for students of Latinx heritage in a middle school in Garner, NC.
- Led and mentored projects to foster engagement and interest in Chemistry for various middle schools in Raleigh, NC.

**High school Chemistry Liaison** – CeiBA Foundation, Quibdo, Colombia **Jun. 2017 – Dec. 2017**

- Assessed the national standardized exam results for the Choco region in Colombia, and presented the results to stakeholders and coworkers, aiming to discuss policy changes and pedagogical strategies.
- Salvaged, organized, and reequipped decommissioned chemistry laboratories in two public school in Itsmina & Quibdo (Colombia).
- Developed a storage, handling and cleanup guide of common chemical substances for a chemistry laboratory at a public school.
- Established cooperation between a chemical waste management company in Medellin and a laboratory in Quibdo for the safe removal of hazardous waste.
- Coordinated local high school teachers to update the chemistry curriculum in two public schools.
- Designed, developed, institutionalized & carried out laboratory practices aligned with the updated Chemistry curriculum. Practices included Ideal Gas Demonstrations, Lemon Batteries, Red Cabbage Indicator, and Preparing Hand Cream.
- Conducted school visits to supervise, support and work alongside local chemistry teachers at two public schools.
- Encouraged students from underrepresented communities by promoting their academic empowerment through chemistry divulgation activities.
- Advised high school seniors in their search for scholarships, housing, and universities in major metropolitan areas in Colombia.
- Delivered Science communication and Chemistry lectures for High School Seniors in both small groups (25 students per class) and auditorium settings (100+ students).

**Elementary Science Teacher** – Montessori British School, Bogota, Colombia **Jan. 2017 – Jun 2017**

- Prepared, organized and taught science classes in English for $4^{th}$ and $5^{th}$ grade students.
- Developed study plans and learning strategies for low-achieving students and communicated the guides to their guardians.
- Designed, implemented and taught safe science laboratory procedures for $4^{th}$ and $5^{th}$ grade students. Procedures included: identifying types of leaves, mangroves & beach erosion, zinc & copper batteries, lemon batteries, simple circuits, reading climate change charts.
- Coordinated lectures with other teachers to create interdisciplinary blocks in critical topics.
- Managed the students' extracurricular environmental science group to promote science communication and environmental awareness.

**Adjunct Faculty** – Universidad de Los Andes, Colombia **Jan. 2015 – Jun. 2017**

- Prepared assignments and taught lectures for Organic Chemistry I & II Labs for Chemistry majors. Topics included multistep reflux synthesis, microwave synthesis, verification laboratories for carbonyl compound reactions, H-NMR, FTIR, GC, extraction & purification methods.
- Created, developed, and implemented two laboratory courses for $4^{th}$ and $5^{th}$ grade kids: "Cool Experiments for Kids", and "Arts and Sciences School". Versions of both courses are still taught to this day in Universidad de Los Andes. The experiments included: bicarbonate rockets, elephant toothpaste, science of bubbles, lemon batteries, and milk-based paint.
- Created, developed, and implemented a laboratory course for $10^{th}$ and $11^{th}$ grade kids called "Introduction to Forensic Sciences", where I covered the following topics: collecting evidence from a mock crime scene, protecting the chain of custody, blood type determination, and fingerprint determination.
- Administrated the budget and acquired the necessary materials and chemicals for each laboratory session.
- Taught the 'Chemistry Induction' class to first-semester Chemistry majors to explain the career's applications, trajectory and possibilities.
- Regularly performed Chemistry demonstrations for middle school students at an international private school.

**Teaching Assistant** – Universidad de Los Andes, Colombia **Jan. 2012 – Dec. 2014**

- Prepared assignments and taught lectures for Organic Chemistry I & II Labs for Chemistry majors. Topics included multistep reflux synthesis, microwave synthesis, verification laboratories for carbonyl compound reactions, H-NMR, FTIR, GC, extraction & purification methods.
- Implemented and lead seminars to foster effective oral presentations of laboratory results.
- Arranged and carried out demonstrative experiments for scouting and outreach purposes.

## Publications

- E. Echeverri-Jimenez and M. Oliver-Hoyo, "Gaussian-2-Blender: An Open-Source Program for Conversion of Computational Chemistry Structure Files to 3D Rendering and Printing File Formats" *Journal of Chemical Education* **2021**, *98*, 3348-3355 doi: 10.1021/acs.jchemed.1c00515
- E. Echeverri-Jimenez and M. Oliver-Hoyo, "Extracting, Describing and Representing Spatial Features of a Chemical Reaction inside a Virtual Reality Learning Environment," *2021 7th International Conference of the Immersive Learning Research Network (iLRN)*, **2021**, pp. 1-3, doi: 10.23919/iLRN52045.2021.9459399.
- E. Echeverri-Jimenez and M. Oliver-Hoyo, "Visual-Spatial Skills, Strategies, and Challenges to Extract, Represent and Predict Stereochemical Outcomes of Cycloadditions using a Hexagonal Prism Reference Frame" *Journal of Chemical Education* **2022**, In Revision February 2023.

## Conferences & Presentations

- Echeverri-Jimenez, E.; Wright, L. **2022** "Symposium on Extended Reality in Chemistry Education" *2022 Biennial Conference on Chemical Education*.
- Echeverri-Jimenez, E.; Oliver-Hoyo, M. T. **2022** "Developing a virtual-reality learning environment to teach cycloaddition reactions at the graduate level: Introducing new technologies to the teacher's toolbox" *2022 Biennial Conference on Chemical Education*.
- Echeverri-Jimenez, E.; Oliver-Hoyo, M. T. **2021** "Extracting, describing and representing spatial features of a chemical reaction inside a Virtual Reality Learning Environment" *International Conference of the Immersive Learning Research Network.* Online.
- Echeverri-Jimenez, E.; Oliver-Hoyo, M. T. **2021** "The development of a Virtual Reality Learning Environment (VRLE) using shape recognition frameworks to visualize organic reactions" *Latin American Research Symposium NC State University.* Raleigh, NC.
- Echeverri-Jimenez, E.; Oliver-Hoyo, M. T. **2020** "Developing a virtual-reality learning environment to teach cycloaddition reactions at the graduate level: Introducing new technologies to the teacher's toolbox" *2020 Biennial Conference on Chemical Education*. Because of the global COVID-19 pandemic, the 2020 BCCE was terminated and this presentation could not be given as intended.
- Lizarazo C., Echeverri-Jiménez, E. **2014** "Demonstrative Experiments: Fun chemistry for kids." *31st Latin American Chemistry Congress – Chemical Education Section.* Lima, Perú.
- Echeverri-Jiménez, E., Gamba-Sánchez D., **2013** "Natural products as precursors of chiral protonating agents." *Tetrahedron symposium for organic and bio-organic chemistry*, Vienna, Austria.

## Leadership Experience

**Biennial Conference on Chemistry Education: Symposium organizer –** American Chemical Society **July 2022**

- Organized an Extended Reality in Education Symposium for an ACS specialized conference.
- Recruited experts in XR in Chemistry Education for prospective talks for the upcoming BCCE conference.
- Evaluated and curated abstracts in Extended Reality in Chemistry Education for the participation in the symposium.
- Will give an oral presentation about the design, development and assessment of a Virtual Reality Learning Environment to study Advanced Organic Chemistry.
- Will preside a space to discuss Extended Reality (XR) topics in Chemistry Education the symposium.

**Chemistry Graduate Student Association: Tutoring organizer –** NC State University **Jan. 2020 – Dec. 2021**

- Organized organic chemistry and general chemistry final exam study sessions for undergraduate students.
- Recruited graduate students as volunteers for tutoring undergraduates with the purpose of collecting funds for the Chemistry Graduate Student Association.
- Lead the publicity efforts, including flyer designs, social media presence, and the gathering of undergraduates students interested in the tutoring sessions for the fundraiser event.

**Latin American Student Association: Board member** – NC State University **Jan. 2019 – Dec. 2019**

- Lead the fundraising efforts in preparation for the Latin American Research Symposium.
- Coordinated the research symposium, organized abstracts in themes, and recruited judges for the poster competition.
- Prepared and presented demonstrations and experiments to encourage scientific thinking for middle school students of Latin heritage.
- Served as a translator from English to Spanish for exchange students in a project from the College of Agriculture and Life Sciences at NC State to train agricultural leaders in Latin America.

**High School students' mentor –** Universidad Tecnológica del Chocó **2017**

- Mentored high school graduates from mostly indigenous and/or afro communities in a historically neglected region of Colombia, in their search for their academic path, including options for funding, scholarships, and career paths in science.

## Technical skills

- **Languages:** Spanish (Native), English (C2), German (A2)
- **Programming Languages:** Python, C#, cypher, HTML5, CSS3
- **Research:** Systematic literature reviews, academic publications, scientific illustrations, creative problem solving, resilience.
- **Interpersonal:** Semi-structured interviews, public speaking.
- **Data Analysis & Visualization:** Excel, Dedoose, MaxQDA, R
- **Computational Chemistry:** Gaussian, Turbomole
- **Game Development:** Unity
- **Modeling and Animation:** Blender, Maya, Gimp, Inkscape

## Distinctions

- **First place** in the poster competition at the Annual Chemistry Department Research Symposium at NC State **2022**
- **Second place** in the poster competition at the Latin American Research Symposium at NC State **2021**
- **Distinguished Alumni Feature** for Circuit Stream Extended Reality Development Class **2021**
- **Highest National Score** in Chemistry at the SABER-Pro standardized test in Colombia **2012**