

Balraj B. Rathod

Chemist | Science Education Researcher | Designer

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Portfolio: <https://balrajrathod.design/>

EDUCATION

2012 - 2017 **Indian Institute of Science Education and Research (IISER) Kolkata**

Master of Science (MS) | Chemical Sciences (Integrated BS-MS Dual-Degree Programme) | GPA: 7.74/10.0
Thesis: The Sound and Feel of Titrations: A Smartphone Aid for Color-blind and Visually Impaired Students
Supervisor: Prof. Subhajit Bandyopadhyay

Bachelor of Science (BS) | Chemical Sciences

WORK EXPERIENCE

2017 - Present **Indian Institute of Technology Bombay (IITB) | Educational Technology Group / Research Associate**
Supervisors: Prof. Sahana Murthy and Dr. Gargi Banerjee

- Worked on design-based research projects focussing on learner-centric technology integration within introductory chemistry labs and middle-school geometry curriculum. Co-authored journal and conference articles.
- Conducted a workshop for middle-school science students for exploring socio-scientific issues within Mumbai city.
- Assisted doctoral students for designing user interfaces and testing of technology-enhanced learning environments.
- Consolidated department's educational research, development, and outreach efforts for quick referencing and dissemination through infographics.
- Designed and developed the website for the department research strand for teacher use of ICT.
- Helped organize training workshops for pre-service teachers and school principals.
- Spearheaded an academic collaboration for science education research between IIT Bombay and IISER Kolkata.

May - July 2015 **Aalto University, Helsinki-Finland / Research Assistant** at NeuroCine Research Group
Supervisors: Dr. Pia Tikka (Filmmaker and Research Professor) & Dr. Jaakko Kauramäki (Neuroscience Researcher)

- Co-designed and set up the empirical framework for studying non-verbal interactions during a narrative comprehension activity. The setup involved synchronized acquiring data consisting of (a) face tracking data using Microsoft Kinect, (b) EEG Brain Data (c) infrared imagery (d) psychophysiological signals. Conducted user studies (n=24).

PUBLICATIONS | BODY of RESEARCH WORK

Research Interests: Inquiry-based Learning within Socio-Scientific Controversies | Argumentation | Technology and Science Education

- 2019 ● **Rathod, B. B.** & Murthy, S. **What's worth solving? Facilitating problem-finding through collaborative argumentation within a socio-scientific issue.** Under review at the *International Journal of Science Education*
- Motivation: How can vaccine-related misinformation WhatsApp messages affect a mass measles vaccination campaign? What probable problems can it cause? The ability to identify gaps in understanding and problems is central to the scientific process and can assist in taking timely actions.
 - My Role: Conducted an instrumental case study on Twitter with three STEM domain experts as participants for collaboratively negotiating the controversial SSI of a plastic ban in Mumbai, India. Used qualitative research methods of content, thematic, discourse analysis. Identified strategic use of collaborative argumentation and reasoning practices required to do problem discovery.
 - Impact: The results of this study can inform the design of specialized problem finding activities. It can help middle-high school learners to find meaningful science project ideas around issues they care about.
- 2019 ● **Rathod, B. B.**, Murthy, S., & Bandyopadhyay, S. (2019). **Is this Solution Pink Enough? A smartphone tutor to resolve the eternal question in phenolphthalein-based titration.** *Journal of Chemical Education*, 96(3), 486-494. DOI: 10.1021/acs.jchemed.8b00708
- Motivation: In a large classroom setting such as introductory chemistry labs, it can be difficult for instructors to provide individualized feedback to students at regular intervals. How to enable students to independently evaluate their experiment?
 - My Role: Designed and developed a smartphone-based tutor application targeted to elicit students' reasoning for self-assessing their experiment performance. Conducted a mixed-methods research study using structured interviews and Likert surveys (n=17 undergraduate students) to understand the usefulness of the learning intervention.
 - Impact: The project is aimed to engage students to independently monitor their experiment performance by self-assessment with minimal teacher support.
- 2017 ● Bandyopadhyay, S., & **Rathod, B. B.** (2017). **The sound and feel of titrations: A smartphone aid for color-blind and visually impaired students.** *Journal of Chemical Education*, 94 (7), 946-949. DOI: 10.1021/acs.jchemed.7b00027
- Motivation: Chemistry has an inherent visual nature. How to enable color-blind and visually impaired students to participate in laboratory activities involving color changes in chemical solutions?
 - My Role: Designed and developed a smartphone camera-based learning aid that translates a chemical color change into sound and tactile feedback. (MS in Chemistry Thesis Work)
 - Impact: Till date, the scalable deployment of the aid has reached out to over 6000 students and teachers across 30+ Countries. Subsequently, the reviews and discussions with instructors indicate that they have incorporated the support into their laboratory curriculum to assist visually impaired students in detecting chemical color-changes.

2018

Kaur, N., Pathan, R., Khwaja, U., Sarkar, P., **Rathod, B.**, & Murthy, S. (2018, December). **GeoSolvAR: Augmented Reality Based Application for Mental Rotation.** In 2018 *IEEE Tenth International Conference on Technology for Education (T4E)* (pp. 45-52). IEEE. DOI: 10.1109/T4E.2018.00017

- Motivation: Spatial visualization skills like mental rotation aid landscape architects and structural engineers to be able to deconstruct objects and identify probable designs mentally. How to train high school students for doing such mental rotation tasks?
- My Role: Assisted in the design and development of web-based augmented reality-enabled 3D geometry learning activities for mental rotation. Conducted research studies with six high school learners. Used content analysis methods to identify learners' productive interaction patterns for completing an activity.
- Impact: The learning activities were designed for teachers to be able to integrate mental rotation tasks within existing high school geometry curriculum.

ONGOING RESEARCH PROJECT

2018-

Development of a Low Cost Tool for In-field Monitoring of Water Quality via Color and Turbidity Analysis
Supervisor: Prof. Subhajit Bandyopadhyay, IISER Kolkata

- Motivation: To the majority population, the visual appearance or the turbidity of water is perhaps the only criteria to define its drinkability. However, for the measurement of turbidity, there remains a severe lacuna in terms of low-cost, accessible, and easy-to-use technology that can be operated by individuals with no expertise in handling scientific instruments.
- My Role: Designed a prototype cardboard-based dock for water sample testing. Analyzed colorimetric data of turbid water to devise a correlation algorithm for measuring turbidity using a smartphone camera. Conducting water samples' quality testing.

AWARDS and RECOGNITIONS

2017

Interaction Design Association (IXDA) 'Intel Student Design Challenge' | New York City, USA
Winner - Global 1st Prize

- Selected as one of the six finalists from around the world for the design challenge at the 'Interaction 17' conference.
- My MS thesis project idea for aiding color-blind students to navigate through their daily tasks using multisensory perception won the First Prize.

2017

Best Performing Student of the Year Award | Department of Chemical Sciences, IISER Kolkata

2017

Master of Science Best Thesis Award | Department of Chemical Sciences, IISER Kolkata
Runner-up

(2012 - '17)

INSPIRE (Innovation in Science Pursuit for Inspired Research) Fellowship
Department of Science and Technology, Government of India

- Awarded for being in the top 1% ranked students of Maharashtra State in 12th grade.

SKILLS

Adobe Photoshop	●●●●●●●●
User Interface Design	●●●●●●●●
AfterEffects	●●●●●●●●
Dreamweaver	●●●●●●●●
Android App Development	●●●●●●●●
Sony Vegas Pro	●●●●●●●●
Java	●●●●●●●●
HTML/CSS/Web Design	●●●●●●●●

Research Methods

Qualitative: Thematic, Content, Discourse Analysis
Interviews, Focus Group
Quantitative: Basic Statistical Analysis

RELEVANT COURSEWORK

- Introduction to Educational Technology (Sit-through, IIT Bombay), 2017
- Research Methods in Educational Technology (Sit-through, IIT Bombay), 2018
- General Physical Chemistry
- Physical and Theoretical Chemistry Lab
- Introductory Biophysics
- Evolutionary Biology
- Chemistry of Natural Products
- Bioinorganic Chemistry
- Reaction Mechanisms in Organic Chemistry
- Chemical Perspectives of Biological Pathways
- Chemistry of Materials
- MS Thesis Research Project

As part of my undergrad and master's curriculum, I took interdisciplinary courses in physics, biology, mathematics, computer science, geology, and humanities.

POSITIONS of RESPONSIBILITY and EXTRACURRICULAR ACTIVITIES

2017-Present

Internship Mentor, IIT Bombay

- Mentored 8 department interns (final-year undergraduate students) for structured academic writing (drafting work reports) and effective public presentation skills (posters, paper-reading activities).

2018

Graphic Designer, 18th IEEE International Conference on Advanced Learning Technologies (ICALT), Mumbai

- As the creative lead, I designed the conference branding needs and coordinated with the organizing team of 25+ members. Students and researchers from over 40 countries participated in the conference.

May 2015 - June 2015

Aalto University Design Factory, Finland | Creativity and Innovation Course

- Engaged in over 150 hours of teamwork to storyboard a solution to a daily life challenge conditioned by individualistic behaviour. I was a part of a five-member multi-disciplinary team which focused on limiting food waste in buffets.

2015

Lead Designer and Co-Editor of 'Muse' (Annual Literary Magazine, IISER Kolkata)

- As a member of the editorial board, compiled and categorized over 50 articles and poems.
- Designed the magazine's cover art and illustrations.

2014 - 2015

Institute Student Council Member, IISER Kolkata

- Elected to represent 1000+ undergraduate and graduate students, leading 7 club Secretaries (Dance, Dramatics, Literary, Music, Movie, Photography, and Arts) to enhance cultural avenues for students.

2014

Core Organizing Committee Member, Inquivesta (Annual Science Festival, IISER Kolkata)

- Elected as the creative lead for the Inquivesta, widely regarded as India's largest science festival.
- Designed publicity needs and festival arena layout. Coordinated graphic design needs with 50+ team members.
- Conceptualized a competition titled 'Science in a Minute' which involved participants explaining complex scientific phenomena in layman terms.

2014 - 2017

Animal Welfare Team, IISER Kolkata

- Part of student-led initiative for rescuing free ranging dogs and cats on campus.
- Managed vaccination drives, injury treatments, and participated in quarterly population checks.
- Oversaw daily feeding (We used leftover food from the institute cafeteria).

MY IDEAS of FUN

- Designing minimalist movie and book themed posters.
- Digital painting.
- Writing letters to the authors of the book I have read.
- Designing T-shirts with quirky science quotes.
- Occasionally doubling as an amateur Mumbai city tour guide.
- Formula-1 Races.
- and Saying Hi to Dogs.