Visualisations and representations in chemistry education

You are invited to submit contributions to the *Chemistry Education Research and Practice (CERP)* special themed issue on visualisations and representations in chemistry education, scheduled for publication in autumn 2019. Manuscripts should be submitted by Monday 25 February 2019 to be eligible for consideration in the themed issue.

Chemistry Education Research and Practice

CERP is the international peer-reviewed research journal for teachers, researchers and other practitioners in chemistry education, published by the Royal Society of Chemistry (RSC). The editor is Dr. Michael K Seery, University of Edinburgh, UK.

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Visualisations and representations in chemistry education

As advancements in technology continue to unfold, visualisations and, more broadly, representations in chemistry education have evolved into sophisticated representations that take into consideration experimental and computational findings as well as research on learning. Historically, early studies on visualisations were focused on how viewing pictures or animations of entities at the submicroscopic level affect conceptual understanding of the invisible world of chemistry. Consequently, much research was devoted to the manner in which visualisations could help students connect the particulate nature of matter with macroscopic processes such as laboratory experiments and demonstrations.

Educators recognise that visualisations and representations can help students form bridges from the particulate level to the symbolic level associated with equations and graphical or mathematical models. In essence, a primary goal of instructional visualisations is to assist students to develop more expert-like understanding of chemistry. Yet, visualisations have been shown to be limited in their bridging capacity and affordances. Not all students are able to understand what they view or to comprehend the complex processes portrayed through dynamic models.

These limitations have led designers to consider how to engage learners cognitively with visualisations through interactive features. For example, simulations allow students to manipulate variables and to observe the consequences of their actions, especially at the submicroscopic level. Studies connected to cognitive load and how complexity and accuracy can best be used to portray the submicroscopic level are also being carried out. Research studies have continued to explore how visualisations in three dimensions compare to those in two dimensions, and how virtual reality and augmented reality can assist learning and understanding of structural and functional entities. In addition, studies are exploring how students make sense of the submicroscopic level through their hand-drawn representations, oral explanations and their ability to reflect metacognitively on their understanding. Furthermore, eye-tracking technology has given researchers the ability to identify where students focus while they view visualisations.

This special themed issue intends to illustrate how the design and study of learning from visualisations and representations in chemistry education have progressed. It also intends to offer insight into the implications for our teaching practice.

Possible topics may include but are not limited to:

- Development and design principles of animations/simulations/virtual and augmented reality tools
- The use of drawings and storyboarding to make sense of representations
- Tools for using animation development and understanding student-generated animations
- 2D and 3D visualisations, 3D printing, haptics, or novel visualisation tools
- Design and use of representations for students with special needs (eg visually impaired students)
- Connecting representations to experimentation (eg laboratory and demonstrations)

- Eye-tracking research advancements
- How visualisations/representations can help us better understand ‘big data’
- The influence of chemistry visualisations in chemistry courses at school, college, and university levels including in specialist courses and when learning chemistry concepts taught in cognate subjects
- The role of visualisations in understanding models and connections to scale
- Development of metavisualisation skills
- Integration of different types of representations in teaching chemistry at macroscopic, symbolic, and particulate levels
- Qualitative and quantitative analytical methods for addressing learning and teaching with visualisations and representations

Articles should:

- Align with the principles and quality criteria of the journal[1]
- Provide an argument for new knowledge supported by careful analysis of evidence
- Be situated in existing literature, and either report the meaningful analysis of carefully collected research data or the rigorous evaluation of innovative practice

Guest editors

The guest editors for this themed issue are:

- Resa Kelly (Department of Chemistry, San José State University, San José, US)
- Sevil Akaygün (Department of Mathematics and Science Education, Bogazici University, Istanbul, Turkey)

Submission of manuscripts

Manuscripts should be submitted in the format required using the ScholarOne online manuscript submission platform.

General guidance on whether the theme of a contribution falls within the scope of the journal may be found in a published editorial.[2] Enquiries concerning the suitability of topics of potential contributions for the theme issue should be sent directly by email to one of the theme editors: Resa Kelly (resa.kelly@sjsu.edu) or Sevil Akaygün (sevil.akaygun@boun.edu.tr).

Acceptance and publication

Manuscripts should be submitted by **Monday 25 February 2019** to be eligible for consideration in the themed issue. All manuscripts will be subject to editorial screening and peer review. Manuscripts received after the deadline may still be considered for the theme issue, but the usual peer review process will not be compromised to reach decisions on publication. If such articles are accepted for publication too late to be included in the theme issue, they will be included in a subsequent issue.

As with other *CERP* contributions, articles intended for the theme issue will be published as advance articles online as soon as they have been set and proofs have been checked, ahead of publication in the theme issue itself. Authors also have the option of accepted manuscript publication, where a pdf of their accepted manuscript is published immediately after acceptance (to be substituted by the professionally set and proofed copy once available).

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[1] K S Taber, *Chem. Educ. Res. Pract.*, 2012, **13**, 4 (DOI: 10.1039/C1RP90058G)
[2] K S Taber, *Chem. Educ. Res. Pract.*, 2013, **14**, 151 (DOI: 10.1039/C3RP90003G)