An interview with Vicente Talanquer

János Sándor Kapitány and Zoltán Tóth

University of Debrecen, Hungary

János Sándor Kapitány PhD Student
Doctoral School of Chemistry, University of Debrecen, Wesselényi Miklós Technical Secondary and Vocational School,

Zoltán Tóth Associate Professor
Group of Chemistry Didactics, Institute of Inorganic and Analytical Chemistry, University of Debrecen

Correspondence concerning this article should be addressed to János Sándor Kapitány, Doctoral School of Chemistry, University of Debrecen, Hungary, Debrecen, Egyetem tér 1.
Contact: kapitany.janos@gmail.com

Abstract

Vicente Talanquer got his BSc (1985), MSc (1987), PhD (1992) degree from chemistry at the National University of Mexico (Universidad Nacional Autónoma de México, shortend UNAM) in Mexico, where he worked until 2000 as a professor. He taught also at the University of Chicago. At now he is an associate professor at the University of Arizona in the Department of Chemistry and Biochemistry, where his research field is the chemical education and he lectures at general chemistry and physical chemistry courses. He published more than 50 articles in international referred journals, and wrote 10 textbooks from those four is used by all primary school students in Mexico.Vicente Talanquer is an editorial board member for the International Journal of Science Education, an editorial board member for the Journal of Research in Science Teaching, a member of the Science Academic Advisory Committee (College Board), he was a member of the Task Force on Division Outreach. ACS, Chemical Education Division, a member of the Task Force on

Strategic Planning. ACS, Chemical Education Division. Ad hoc reviewer at numerous journal, e.g. Journal of Chemical Education.

Resumen. Vicente Talanquer obtuvo su Licenciatura (1985), MSc (1987), PhD (1992) Grado de Química de la Universidad Nacional de México (Universidad Nacional Autónoma de México, UNAM shortend) en México, donde trabajó hasta 2000 como profesor. Enseñó también en la Universidad de Chicago. En él ahora es un profesor asociado en la Universidad de Arizona en el Departamento de Química y Bioquímica, donde su campo de investigación es la enseñanza de la química y él da clases en la química general y cursos de química física. Ha publicado más de 50 artículos en revistas internacionales se refiere, y escribió 10 libros de texto de los cuatro es utilizado por todos los estudiantes de la escuela primaria en México. Vicente Talanquer es miembro del consejo editorial de la Revista Internacional de Ciencias de la Educación, miembro del consejo editorial de la Revista de Investigación en Enseñanza de las Ciencias, un miembro del Comité Asesor Académico de Ciencias (College Board), que era un miembro del grupo de trabajo sobre Extensión división. ACS, División de Educación Química, un miembro del Grupo de Trabajo sobre Planificación Estratégica. ACS, División de Enseñanza de la Química. revisor ad hoc en numerosos diario, por ejemplo, Journal of Chemical Education.

Keywords: science teaching, chemistry-related pedagogy, teacher education

Honors and awards

2012. James Flack Norris Award for Outstanding Achievement in the Teaching of Chemistry. Northeastern Section of the American Chemical Society.
2012. Henry and Phyllis Koffler Prize in Teaching. University of Arizona
2007. Leicester & Kathryn Sherrill Creative Teaching Award. University of Arizona.
2006. Five-Star Teaching Award. University of Arizona.
2004. Early-Career Teaching Award. College of Science, University of Arizona.
1998. Outstanding Young Professor in Physical Sciences Education. UNAM (Mexico).
1997. First place in the national contest "Science History for Secondary School Students." The Mexican Academy of Sciences, May 1997.
1996. Best Doctoral Student in Chemistry (First in the class of 1987-1989). UNAM (Mexico)
1990. Member of the National Research System of Mexico. National Researcher. Candidate: 1990-1993. Level I: 1993-1999. Level II: 1999 to 2001.
1989. Best Masters Student in Chemistry (First in the class of 1985-1987). UNAM (Mexico)
1986. Best Undergraduate Student in Chemistry (First in the class of 1981-1985). UNAM (Mexico)

Interview

Why did you take up chemistry?

There are two main reasons. 1) I had two excellent chemistry teachers in High School, who made me very interested in the subject. 2) I had interests in mathematics and physics too and my teachers told me that Chemistry, being the central science, would be a good option for me as I would have to learn those other disciplines.

Why did you choose Physical Chemistry for M.S. and Ph.D thesis?

As I said it in my previous question, I was interested not only in learning chemistry, but also physics and mathematics. The college courses that I enjoyed the most and were more intellectually challenging to me were the physical chemistry courses. When I was an undergraduate, I joined a research group in theoretical physical chemistry and that led me to continue my graduate studies in that area.

You got many honors and awards (listed in the biographical sketch). Which one are you proudest for and why?

I am not quite sure there is an award I feel the most proud about. However, if I have to choose, I would select the recent ACS Norris Award. This is the first time that I get a national award in chemical education, which somehow implies that my work is being recognized as valuable beyond the confines of my own University.

How and why did you become a chemistry researcher and educator?

I started my professional career as a researcher in theoretical physical chemistry at the National University of Mexico. I always enjoyed learning and investigating how things worked, and I was priviliged to have the opportunity to pursue my interests. However, I also enjoyed teaching a lot. In fact, before going into graduate school I taught middle school and high school chemistry at a school that we (with some friends of mine) started in Mexico City. I kept teaching a class in that school while I was completing my Masters and Ph.D. When I finished my graduate studies, I went to the US to complete postdoctoral studies at the University of Chicago. When I went back to Mexico, 3 years later, I joined the chemistry faculty at the National University of Mexico, which involved doing research in physical chemistry and teaching undergraduate courses. Short after I came back to Mexico, I was invited to collaborate with a team in charge of writing the national science textbooks for elementary school. That work opened my eyes to the many challenges faced by teachers across Mexico and made my interest in education to grow even stronger. Thus, I started shifting my research interests from physical chemistry to chemistry education.

National University of Mexico (UNAM) Faculty of Science

Why did you choose an academic career?

I think it felt natural to me. I enjoyed learning and teaching. Working in a University seemed as the ideal place for someone like me. It offered me the opportunity to keep learning my entire life, and being engaged in thinking how to improve the learbing of others. What else could be better?

How did you come to your present appointment at University of Arizona?

My first academic appointment was at the National University of Mexico (UNAM). I was hired as an assistant professor in chemistry in 1992. In 1999, the students at UNAM went into a strike because of rising fee issues, and the University was closed for almost one year. During that year, faculty was not allowed to teach or go into their offices to work. My life partner is from the US. Thus, nine months into teh strike we decided that may be I shoudl apply for a faculty position in the US. I did and that is how I ended working at the University of Arizona (UA). This change also allowed me to refocus my research in chemistry education and science teacher preparation, as that was the focus of the faculty position that I took at the UA.

University of Arizona (UA)

Can you tell me something about your chemical education research, especially about trying to characterize the conceptual frameworks and the patterns of reasoning used by chemistry students to answer questions and solve problems that require qualitative reasoning?

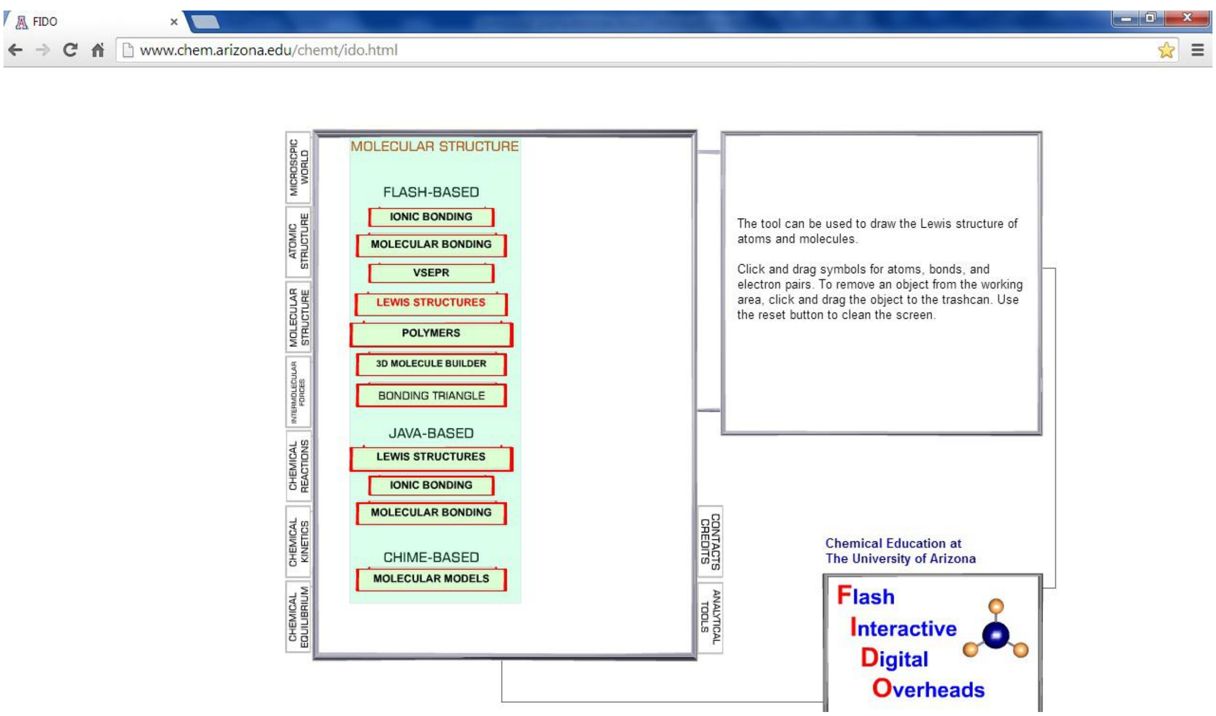
The focus of my research is to try to better characterize how reasoning about chemical entities and processes evolves with training in chemistry, or science in general. There has been considerable research on students' misconceptions in chemistry, but I am convinced that type of research is only scratching the surface of how students think. Thus, we have been trying to identify the underlying implicit assumptions and reasoning strategies that students use to deal with the types of questions and qualitative problems that they encounter in chemistry classes. Our research suggest that students' thinking is subject to the types of cognitive biases that have been identified in research about how people make decisions under conditions of uncertainty.

What did you explore how students' ideas and reasoning strategies evolve as they develop more expertise in the discipline?

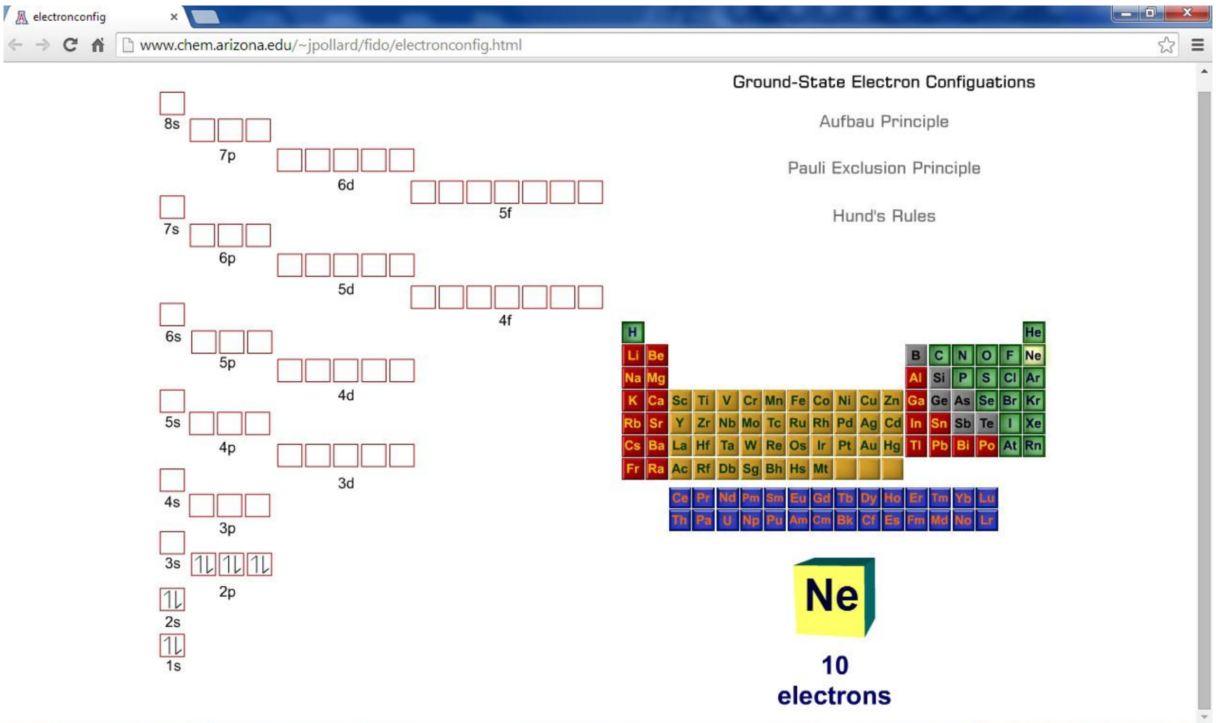
I am not quite sure I understand this question (is it what, or why, or how?). We explore how students' ideas and reasoning strategies evolve because we think that is critical to understand how learning occurs to devise interventions that help people develop meaningful learning. We do it by working with undergraduate and graduate students in chemistry, asking them to complete the same types of tasks and analyzing how they approach their responses. We look to identify differences in the assumptions that the make about the properties and behaviors of chemicals substances and reactions, as well as differences in the strategies that they use to make decisions of what factors are relevant or not in making predictions or explaining phenomena. (Pollard, Talanquer 2005.)

You have made a webpage [w1] with John Pollard where we can find Flash Interactive Digital Overheads. Can you introduce this application for us?

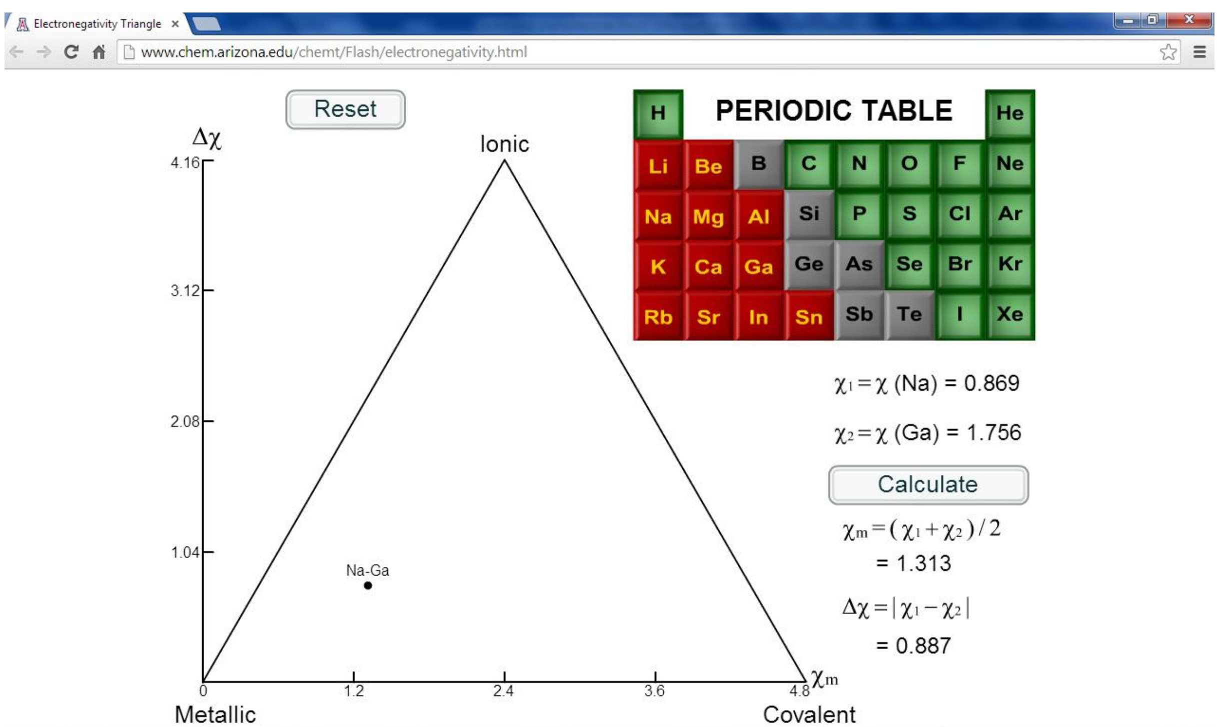
At my University, general chemistry courses are taught in large lecture halls that hold up to 300 students. My colleague, John Pollard, and myself were very interested in more actively engaging these many students in exploring the behavior and properties of various chemical systems. To accomplish that, we started designing interactive animations and simulations that could be easily projected in a large screen in the classroom, and used to pose questions and problems that students could address in small groups. Once they had a potential answer, the interactive tool could be used to explore the actual answers an continue the discussions. That is how the FIDOs came about. Currently, we use these tools in the classroom, but students bring their own laptops and can interact with the simulations on an individual basis and share their ideas with other students. (Singer et al., 2012)) *There is another webpage also made for the general chemistry courses, it's about chemical thinking and useful for learning.* [w2] Below you can see some sample pages from FIDO.



FIDO menu panel



FIDO electron configuration



FIDO electronegativity

How do the chemists relate to your researches in Chemical Education?

Based on my experience with the chemists in my academic department, I would say that they see the results of our research in chemistry education with interest. However, I am not quite sure all of them see the value of what we do. Many chemists seem to have naive views about learning and teaching. Thus, some of them tend to assume that there is not much to know about how students learn or how to teach them. Others are looking for tools or recipes that will help them solve what they see as major problems in their own courses (e.g., what they see as student apathy or students' lack of basic skills). However, I think that younger generations of chemists are more aware of the importance of chemistry education research and the complexities of such type of activity.

What do you think about the present Chemical Education?

Chemistry education has come a long way in the past forty years. At least in the US, there are now many chemistry departments that offer PhD degrees in chemistry with a concentration ine chemistry education. Thus, we have now more chemistry education researchers that have been formally trained to do their job. The number and quality of publications in chemistry education research has also increase considerably during this time. Although the field is still in development, it is becoming stronger every year. However, I think that chemistry education researchers are still a little bit isolated from science educators in other fields, from physics education researchers to science educators interested in K-12 education. I think our field would benefit from more interaction and openess to other fields. I also hope that work in chemistry education research will become more recognized and influential on what actually happens in chemistry classrooms.

You have written many textbooks. What do you think about the modern chemistry textbooks?

My views about chemistry textbooks are mixed. I recognize the existence of a few chemistry textbooks that represent serious and creative attempts to use results from research in chemistry education to approach chemistry teaching in innovative ways. However, the dominant textbooks used by many chemistry teachers at all educational levels tend to be traditional summaries of chemistry knowledge. We need more textbooks that, using what we know about how people learn and about best teaching practices, propose diverse and innovative ways to introduce and develop chemcial ideas in the classroom.

How do you see the status and the future of the subject related pedagogy researches?

Recently, the National Research Council in the US published a book on discipline-based science education research. (Talanquer, 2011) [w3] I know they are working on a second text to promote results from such research using exemplary cases of best practices. That tells me that more people involved in educational policiy in the US are starting to pay attention to discipline-based science education researchers. Thus, I am hopeful that we will see this type of research getting more support and playing a more important role in the research agenda of different universities.

What do you think about the relation of the research and everyday's practise?

Unfortunately, I think that the current status of this relationship is very weak. What we have learned about science teaching and learning is not translating into major changes in everyday's teaching practices. A potential reason for this is that science teaching practices at colleges and universities, where most teachers and instructors are trained, are too traditional. Thus, althoug teacher education courses may promote rearch-based practices, these same prospective teachers go into college science classroom where they are taught in very traditional ways. We need to find ways to transform college education, at the undergraduate and graduate levels, to create a culture of research-based teaching practices that becomes the norm that everybody experiences.

What are your future plans?

I will continue working in my research on learning issues in chemistry education. At the moment, I am collaboarting in a project focused on better understanding learning progressions in chemistry using chemical design as an organizing thread. I am also very interested in understanding how to help prospective and in-service chemistry teachers to become better assessors of student thinking.

Important publications

- Talanquer, V., Chemistry Education: Ten Dichotomies, *Journal of Chemical Education 89*, 1340–1344, 2012.
- McClary, L., Talanquer, V., Heuristic reasoning in chemistry: Making decisions about acid strength, *International Journal of Science Education 3* [10] 1433–1454, 2011.
- Talanquer, V., Pollard, J., Let's teach how we think instead of what we know, *Chemistry Education Research and Practice 11* [2], 74–83, 2010.
- Pollard, J., Talanquer, V., Interactive Digital Overheads: Dynamic teaching tools for the chemistry classroom, *The Chemical Educator 10*, 36–40, 2005.
- Talanquer, V., Recreating a Periodic Table: A Tool for Developing Pedagogical Content Knowledge, *The Chemical Educator 10*, 95–99, 2005.
- Talanquer, V., Morgan, D., Learning to teach: The role of evidence, *Journal of College Science Teaching 34*, 28–32. 2005.

References

Pollard J., Talanquer V. (2005): Interactive Digital Overheads: Dynamic teaching tools for the chemistry classroom. *The Chemical Educator 10*, 36–40

Singer S. R., Nielsen N. R., Schweingruber H. A. (2012): Discipline-Based Education Research, Understanding and Improving Learning in Undergraduate Science and Engineering, National Research Council of the National Academies

Talanquer V. (2011): *How do students reason about chemical substances and reactions? In: G. Tsaparlis and H. Sevian (Eds.): Structural concepts of matter in science education*, Springer

Web references

John Pollard, Vicente Talanquer (2003–2005): Flash Interactive Digital Overheads, http://www.chem.arizona.edu/chemt/ido.html

Vicente Talanquer, John Pollard (2012): Chemical Thinking. Pilot on-line textbook for General Chemistry I., University of Arizona, http://www.chem.arizona.edu/tpp/chemthink/ (password: chem21)

National Academy of Sciences, Research Council, http://www.nap.edu/catalog.php?record_id=13362