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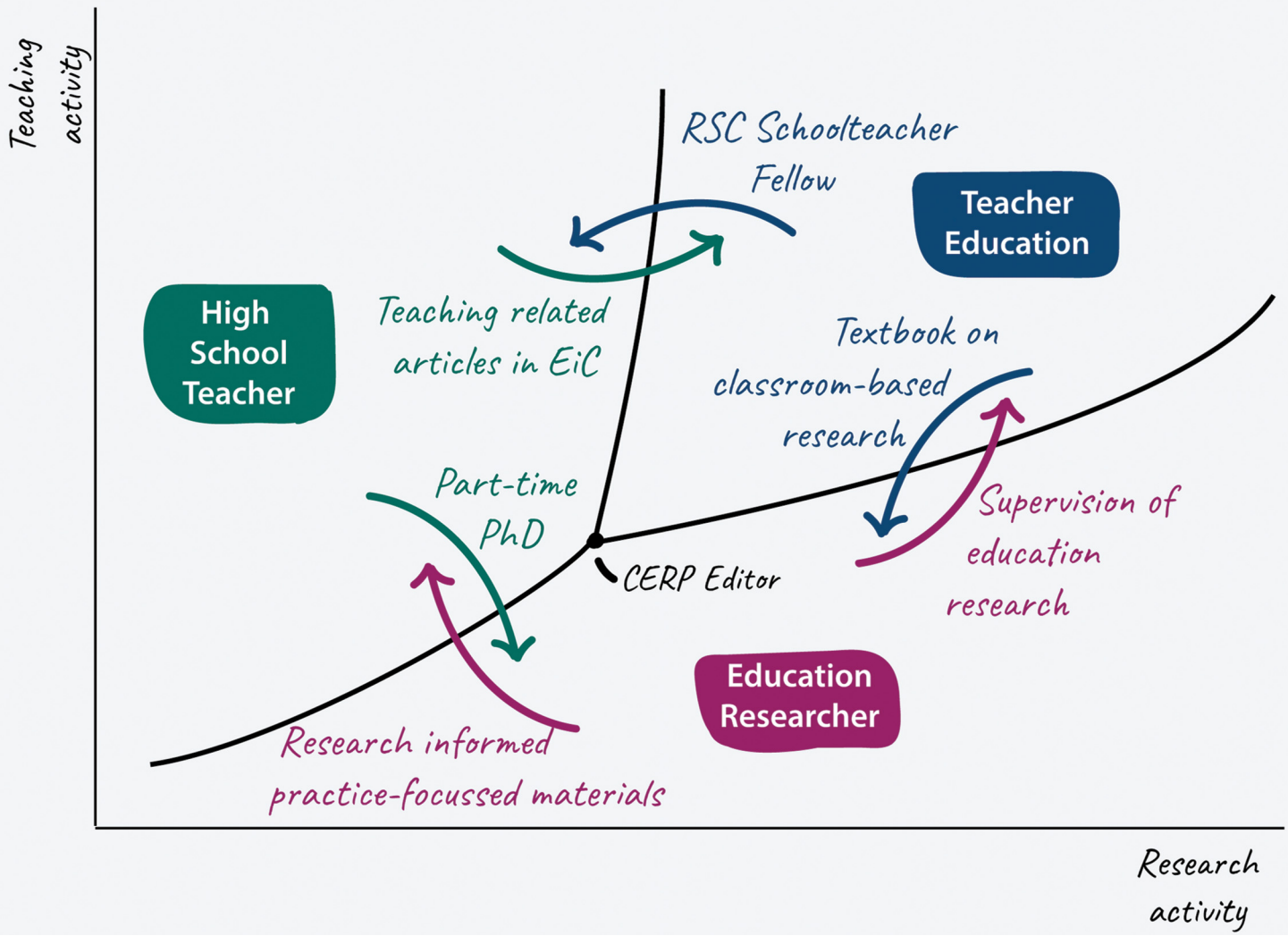
Remembering Professor Keith Taber



ROYAL SOCIETY OF CHEMISTRY

EDITORIAL
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See Taber in Taber: a life lived in science education

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Writing my first editorial of *Chemistry Education Research and Practice* sometime in 2019, soon after succeeding Keith Taber as Editor, was one of the more difficult writing tasks I have undertaken. The challenge was not so much about *what* to say – first editorials commonly include niceties about what has gone before and some intentions about what is to come – but rather about *how* to say it. Keith's editorials were written with such a fierce intentionality and with an argument or guidance grounded in clear reasoning that meant they were particularly distinctive in style. I tended to read them channelling my inner "Taber voice"; the genre of a *CERP* editorial was intimately linked with the manner in which Keith wrote them. Temporarily picking up the pen again to write this editorial is even harder again, as I come to terms with the reality that our discipline has lost an important and intelligent anchor, an ever-critical eye and an always friendly ear, a good man who did much for all of us who care about chemistry education. No doubt in time there will be symposia in his honour and books written synthesising some of his many contributions. I hope this essay dedicated to him can be a small token of reminiscence, as we come to terms with news of his death. And I hope I can write it in a style he would have recognised, or at least enjoyed.

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The three phases of Keith Taber's teaching career

Keith has written that his teaching career had three phases. Having graduated in chemistry from the University of Nottingham in 1981, he completed teacher training at nearby Nottingham Trent University. He became a science teacher, first in Nottingham, before moving to Essex, where he switched from teaching in comprehensive schools to a technical college (in modern parlance, a college of further and higher education). This first phase of Keith's career as a chemistry and physics teacher lasted for 17 years, and in and of itself, indicates a diversity in experiences in teaching contexts and influences. It was evidently incredibly formative; Keith always expressed his identity as that as a science teacher first and foremost.

Keith then entered his second phase around 1999, joining Homerton College, subsequently incorporated into the University of Cambridge's Faculty of Education. He was a university lecturer in science education in the area of teacher education. He continued in this role for over a decade at Cambridge. As the English government's approach to teacher education shifted, he moved into his last phase of his teaching work; that relating to teaching education research methods, training students for doctoral studies as well as those completing an MPhil in Education.

As it is described here, such a career journey is not especially unusual for university academics in science education, but I think what made Keith's career particularly interesting is not so much the phases themselves, but the interactions between them. Keith maintained a list of quotes that he liked (headed "I wish I had said that"), and one example is from Reginald Farrar (Farrar, 1904, p. 193):

"...it must not be forgotten that there are two orders of scholars, the 'intensive' and the 'extensive' school, both necessary to this world – those whose function is original research, and those whose function is to interpret and make available the labours of the former class, whose work would otherwise remain buried under its own weight."

On first reading, this quote suggests that there are people who research, and people who interpret that research for use by others. The "research into practice" challenge is as old as time, and it is well acknowledged that we need "translators" or within a scholarly context, a task elsewhere described as "the engineering of high-quality evidence into a more usable format and presenting it actively or iteratively *via* a respected and trusted conduit" (Gorard, See and Siddiqui, 2020, p. 570). Keith was comparatively unusual in taking up both the

position of the 'intensive' and 'extensive' scholar referred to by Farrar, and was certainly "a respected and trusted conduit". But more interestingly, Keith was akin to Farrar himself in having multiple phases in his career. Farrar was a medical doctor, an administrator, and an inspector; and one can imagine, much of his later career centred on his core identity as a doctor.

The challenge therefore is to consider how activities over a career culminate in forming identity and expertise. Relying on a temporal perspective of thinking about a career – moving from one type of activity onto the next, and so on – means that there is a presumption that identity will shift. But by the end of his career, Keith still identified as a science teacher, and indeed near the beginning of his career, he was engaged in education research. The conundrum then is to think through how these different activities associated with particular career phases interacted.

Keith loved explanatory diagrams, and so to help explain my case, I will try my hand at a Taber-style explainer. When chemists think of phases and interactions, a phase diagram comes to mind. Phase diagrams map the phase of a substance, stating whether it is a solid, a liquid, or a vapour at any given temperature and pressure, so that, for example, at high pressures and low temperatures, a substance is typically a solid. Phase boundaries are drawn on a phase diagram to show the areas in which each phase typically exists, and the interactions between them such as melting, evaporating, subliming, *etc.*, are the processes of transition across these boundaries.

I've adopted the ideas of a phase diagram and the transitions between phases to create a "Taber phase diagram" (Fig. 1). Instead of the axes of pressure and temperature – two major attributes that dictate the identity of a phase of a substance – I am using axes of 'teaching activity' and 'research activity'. Fig. 1 also shows the three main phases of Keith's career, aligned with typical phase regions based on the extent of 'teaching' and 'research' they typically involve. The following discussion of Keith's career draws on this diagram to share some examples of the interactions between these phases based on the kinds of activities he engaged in. The sum of his experiences and expertise over this time is labelled as the "triple point", the point at which all three phases interact, and which subsequently was the basis of his expertise in the role as editor of *CERP*.

Immersing in scholarly research

While Keith was working as a schoolteacher, he began part-time postgraduate study in science education, completing a Diploma, then MSc, and then PhD at the University of Roehampton, London, under the supervision of Professor Mike Watts. This was a remarkably fruitful period, and the pair published six articles together over about a decade on themes and topics that would be lifelong interests. The research centred on student understanding of chemical bonding, with a research programme interested in students' use of anthropomorphic language, their intentionality regarding such language, and exploring this understanding over a period of time (Taber and Watts, 1996). This was soon followed by an in-depth analysis of the conceptual understandings and progressions in thinking of "Tajinder", an A-level pre-university student within a constructivist framework (Taber and Watts, 1997), and culminated in Keith's first article for *CERP*, on student explanations of chemical phenomena relating to the chemical bond (Taber and Watts, 2000). Keith's doctoral studies, completed in 1997 while he was still actively teaching in school, can be characterised as an interaction between his teaching phase and his education researcher phase (Fig. 1); that is to say, research activity that was very much grounded in his own context and identity of teaching high-school chemistry. As well as his work for his PhD, Keith also had an entirely independent strand of peer-reviewed publications in the early nineties on the topic of gender in the science classroom, very much grounded in considering classroom practices (see, for example, Taber, 1992).

Alongside peer-reviewed work, Keith was a regular contributor to *Education in Chemistry*, the Royal Society of Chemistry (RSC) magazine for schoolteachers, as well as other teacher-focussed periodicals including *School Science Review* and *Physics Education*. In his 1999 article for *Education in Chemistry*, he shared some of the outcomes of his own work on his "understanding chemical bonding" project. This included some important teaching-relevant outcomes, such as the tenacity of the octet rule, or the internal contradictions within the chemistry curriculum as viewed from the student perspective (Taber, 1999). This exemplified the focus of sharing outputs of peer-reviewed articles to a broader teaching-focussed audience, drawing on Keith's own particular perspective of teaching and research, and in doing so, so influencing teacher education and development.

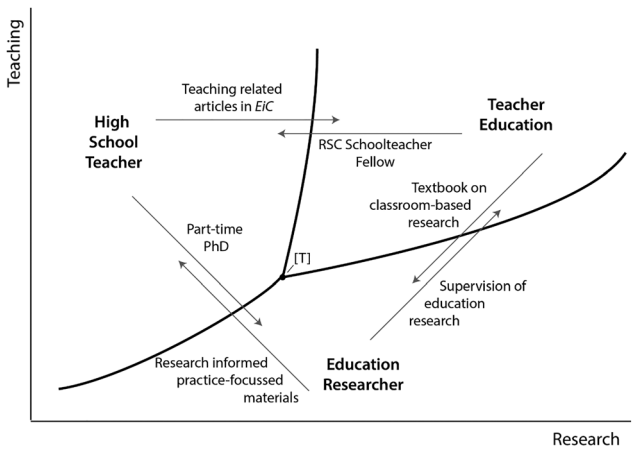

Fig. 1 Taber phase diagram showing Keith's career phased. Point [T] marks the 'Taber triple point', the sum of experiences he brought to being CERP Editor.

Formalising the role of influence

Soon after joining Homerton College, Keith took up an RSC School Teacher

Fellowship, working as a visiting fellow at the Institute of Education, in what was then the University of London between 2001–2002. I think this is one of the most significant moments of his career; he had moved from being a schoolteacher into teacher education, and this opportunity afforded him time to bring together the full weight of his expertise on chemical misconceptions. The output of this fellowship, ''*Chemical misconceptions – prevention, diagnosis, and cure*'' was a two-volume affair; a theoretical background (Taber, 2002a) and classroom resources for practice (Taber, 2002b). A review commissioned by the RSC noted that ''the student resources and guidance for teaching in Volume II were rated exceptionally highly against all criteria. Teachers found the guidance about target level *i.e.* age and ability very effective in supporting their planning'' (Murphy *et al.*, 2004). Both volumes remain available as resources on the RSC Education site.

During his time working in teacher education, Keith was encouraged to become more involved in working with students pursuing postgraduate degrees, and in parallel, there was growing national interest in postgraduate teacher education incorporating more engagement with research. Keith's position at the interface between teacher education and education research provided him with a unique position to help interpret this goal meaningfully. A major culmination of this effort was the production of a textbook ''*Classroom-based research and evidence-based practice*'' in 2007, with a second edition in 2013 (Taber, 2013a). Professor Michael Reiss wrote for the book cover that this book ''is accessible to PGCE students... packed with interesting and valid arguments and shows a great understanding both of classrooms and of educational research''. Keith's interaction between teacher education and education research enabled him to share approaches to facilitate meaningful ''doing'' of education research in the context of classroom teaching.

The transition to education research

This work in education research led to Keith moving on more formally into teaching and supervising education research. He states that his background at that time allowed him to do so ''without feeling too much of a fraud''. Knowing that someone who appeared so capable entertained self-doubts is both heartening and sobering. Nevertheless, his work in education research allowed him space to really expand his horizon of interests. Among this work was the supervision of students, and he established a long track record of student supervision on a variety of topics in physics and chemistry education with a common theme of pedagogical approaches that aligned with student-centred frameworks and perspectives. This last decade of his teaching career – throughout the 2010s – was incredibly prolific, and he continued to research, teach, and write. One core theme in this area was writing for teachers, through his work in writing for *Education in Chemistry* as well as numerous teaching-focussed articles on a variety of topics such as teaching science concepts, diagnostic assessment, scaffolding, *etc.* These combine to form an impressive canon of education-research informed materials aimed at directly influencing practice. Reflecting on the repeated emphases and interactions over the course of Keith's career demonstrates a consistent trend in this regard, an ongoing cycle of focus relating to scholarly practice (Fig. 1).

See Taber in Taber

While my short précis of Keith's career interests cannot do justice to the full extent of his work, there is no doubt that his output and impacts were extensive and influential. Google Scholar reports over 33 000 citations, and a h-index of 68 (these are exceptionally high metrics in any field, and especially so in an education discipline). Keith was promoted throughout his career, ultimately becoming Professor of Science Education at Cambridge University. Given a career-long focus on a number of topics, he would of course cite himself in his writing. While common practice, because of the extent and volume of his own work, my own editorial eye often noticed it, resulting in a smirk and a refrain of ''See Taber in Taber''. I wish I had told him that; I think I would have got a grin back, or at least an eye-roll!

In his case study of Tajinder, the A-level chemistry student, Keith noted an enigma in terms of how the student's development of understanding had grown within the confines of the curriculum, surmising that there must have been different explanatory frameworks constructed by Tajinder beyond, in that case, the octet model. As with any model, there are limits to its explanatory powers, and a limitation of my Taber phase diagram is that it considers Taber the scholar, but not Taber the person. For all of us, pursuing passions and professional interests will be influenced by our life experiences. Where we come from, and who we live our life with, will inform how we experience and explain the world around us.

Keith has shared several insights about his childhood. His mother attended secondary school, and worked in a shop before having her children, returning when they were old enough to be left alone at home. His father's education, interrupted by the second World War, was eventually completed at aged 14. He worked a variety of jobs including repairing ''adding machines'', as a special constable, and as a rent collector. Keith describes life and expectations of him as a child:

Money was always tight, but we were not poor – we always had enough food and serviceable clothes to wear. I was encouraged to do my best at school, but parental expectations were that I should behave and be polite rather than I should do well academically... I certainly did not have a deprived childhood, as I had loving and supportive parents, and (unlike when they had been of school age) the state school system provided encouragement and a vision of the possibility of higher education. However, my family just did not have the cultural capital to know about, or encourage, going to university... I remain very aware of how the complete lack of familiarity with the notion of a university within the family could easily have led to me being persuaded to do what had been expected of me on leaving school – get a job and pay my way.

I think this insight into Keith's early life explains much of his career-long interests, and indeed research approaches. Throughout his work, there is a repeated focus on making sure the learning environment was the best it could be, informed by a deep intellectual underpinning, but also thinking about the realities of practice. For me this explains a lot about Keith's activity in bridging Farrar's 'intensive' and 'extensive' scholarly identities. His belief in the transformative power of education, the role of a teacher in mediating student learning, and the importance of student perspectives in understanding what was happening all stemmed from a deep understanding of the central importance of classroom practice to learners. His interest in what are termed gifted students, and the moral duty to ensure they had a suitably challenging education highlighted that he saw the importance of this practice for all students. I can't help but wonder if the latter interest resonated with his own experiences as a learner; he was, of course, exceptionally clever. Alongside the scholarly activity, the framing in constructivism, the philosophical thinking, and so on, I think we can see an overlying layer of human experience; the individual person is in the scholarship they do. That is to say: we can "see Taber in Taber".

Keith met his wife Philippa in 1988, and they married in 1995. Like Keith, she had a very broad range of interests, intellectual and otherwise, and they lived a very happy and full life together in Cambridge. When she had to give up work due to ill health, she continued studying with the Open University, completing a Bachelor degree and postgraduate diploma in education. Philippa's medical condition became increasingly complex, and Keith cared for her until she died in summer 2016. Because of his commitment to married life, he travelled less than a typical academic of his standing might do. One side effect of this was that he became very internet-savvy much earlier than most, and made major and ongoing contributions to a whole array of teacher forums, social media sites, webinars and online symposia. While it was always nice to meet him in person in London or Cambridge when he was available, much of my knowledge of him is through those online spaces. Keith's own website is itself a treasure trove of insight. He interacted with a vast number of people in different contexts. I have been contacted recently by people from many spheres where he had influence; within his teaching work at Cambridge, but also those whom he likely only ever had digital connections, in chemistry, but also in education more broadly, as well as active participation in the physics education community. Indeed, one of his last contributions is a post in January 2026 to a physics teacher forum; a fitting final act for the self-identified science teacher.

Life as an editor

I first met Keith around 2012. Karen Ogilvie, an RSC staff member in education at the time, had a special skill of bringing together like-minded people to make things happen, and through the auspices of *Education in Chemistry* and elsewhere, Keith, myself, and many others had a lot of fun thinking about new platforms and ways in which RSC education activities could be developed and promoted. It was around this time that Keith became Editor of *CERP*. It was an inspired choice. Keith had inherited a journal that was in good shape thanks to the efforts of the founding editors Stephen Breuer and Georgios Tsaparlis, who had each been editors of *CERP*'s predecessors, *University Chemistry Education* and *Chemistry Education Research and Practice in Europe*, respectively. *CERP* had established itself sufficiently to be listed in the Thomson Reuters citation databases and was moving into the RSC's publication portfolio (meaning professional production processes, back-office support, *etc.*). Keith had a launch-pad from where he could direct where the journal would go next.

Asserting a position for *CERP*

That direction was laid out in a duo of editorials in 2012 and 2013. In his first editorial in 2012, Keith described the types of papers that were appropriate for the journal, outlining the structure of papers, and some general considerations regarding novelty. He also wrote (my emphasis) (Taber, 2012):

When reading an account of an empirical study, readers will normally ***expect the literature review to set out a conceptualisation of the issue or problem being studied****... readers expect the authors to* ***set out and explain the particular theoretical perspective*** *that informs the study. This may be more important in chemistry education than in other areas of chemical science, as the complexity of teaching and learning is such that often each of a range of quite distinct perspectives can offer valuable, complementary insights into different facets of the same educational phenomenon*.

There were similar assertions regarding the role of a formal methodology, and in advocating for particular types of practice in the chemistry classroom, the importance of having a "robust case" for an innovation having a described effect.

The Taber triple point

To understand the impact of these assertions, it is worth pausing for a moment to consider some broader context, at least within the primary RSC dominion of the UK and Ireland. *CERP* is a society journal and as such, there was (and remains) a strong sense of community and belonging around it. Members of the society, and indeed members of the community interested in chemistry education feel some sense of ownership of the journal as a result. His 2012 editorial made clear the benchmark standards for quality and describing what that quality means in terms of the "doing" of scholarly work in chemistry education. But it was not without impact. Establishing a benchmark implicitly means some work would not meet the requirements. This shift from "personal empiricism" to a scholarly pursuit was happening elsewhere too (Cooper and Stowe, 2018), but at *CERP* it felt a little more personal.

I say all this as Keith cannot have been blind to those repercussions, but as I hope the phase diagram considerations above demonstrate, this approach was at the very core of who he was as a science teacher and an education researcher. Chemistry students learn that the triple point is where solid, liquid, and

vapour phases coexist in equilibrium and I think the Taber triple point – the different phases of his career informing his world view of teaching, teaching education, and researching education – gave him an unusually insightful position to advocate his stance. From his perspective, there was a moral imperative to the students with whom we work to require that published work in a peer-reviewed journal had a theoretical basis and a sound evidential outcome. And so it was brave, in my view, to articulate these stipulations, although perhaps he would not have seen it in such terms. Either way, it is the main reason why I think his selection for the role of Editor at that time was ultimately a very good choice for all of us.

Keith's second editorial of the duo also had substantial ramifications. In describing three ''levels'' of chemistry education research, Keith made a clear distinction between what was appropriate for a discipline-based education journal, and what was not (Taber, 2013b). Outside the box was work that he categorised as ''collateral''; activity that just so happened to be situated in a chemistry classroom, but did not offer any insight regarding chemistry itself – either specifically to chemistry students, or to our understanding of learning chemistry. This position was again not without repercussions, but together this duo of editorials set the tone for *CERP* for the remainder of his tenure. In 2019, when I had to write that daunting first editorial, I did so with the team of associate editors (including the editor succeeding me, Gwen Lawrie, and the current editor, Scott Lewis). We amplified and reasserted much of the direction laid out by Keith in his early editorials (Seery *et al.*, 2019).

From my perspective now living the care-free life of a former editor, I can say the discourse arising from those editorials and our reassertion of them continued long past their writing. There were ongoing challenging conversations, especially in a world where publication activity and job performance are so interlinked. My guiding star in these cases continued to be Keith's moral argument about what is in the best interests of students. More recently, as various predatory and similar journals have flooded the publishing landscape, the role of a society journal in advocating for a high-quality benchmark within a disciplinary context has become more important than ever.

Editorial expansion

CERP grew substantially under Keith's tenure, and by about 2015 (and in reality, likely long before), its editorial oversight became too much to be the responsibility of one person. I was recruited as an Associate Editor. My own stories to share belong elsewhere, but it is safe to say that this was a wonderful time; Keith was a generous mentor; kind, full of energy, and never yielding on standards. I learned a lot. After Philippa died in 2016, he began to talk about stepping down; he was worried about his concentration. Through his grief, he somehow managed to find the energy and drive again, and continued on until 2019, building a much more sustainable editorial infrastructure. When he retired, I took up the position, and the work with the Associate Editors continued to build on the standards and processes established by Keith and his vision for the journal. Today the journal remains the premier one in its field, and was recently given ''Diamond'' access status, meaning that articles are available freely online, and the article processing charges are covered by the publisher. This status – currently only attributed to *CERP* and the RSC's flagship journal *Chemical Science* – is a measure of the status the journal enjoys within the broader chemistry landscape.

Life after *CERP*

Keith's retiral coincided with another intellectual avenue to explore. The RSC were interested in developing a book series for chemistry education and Keith was appointed editor of the *Advances in Chemistry Education* series. Books have been published in this series since 2018 on a range of topics, their recurring signature is the bridging of connections between education research and the realities of practice. Recent contributions include those from Professor Vicente Talanquer on understanding chemical thinking (Talanquer, 2026), and from Dr Jane Essex on inclusive and accessible chemistry education (Essex, 2026). Most recently completed and due for publication is one from Dr Naomi Hennah on oracy in chemistry education (Hennah, 2026). Alongside editing these diverse contributions, Keith himself published two books in the series, ''*The Nature of the Chemical Concept: Re-constructing Chemical Knowledge in Teaching and Learning*'' (Taber, 2019) – summarising a lifetime of expertise on this topic – and ''*Chemical Pedagogy: Instructional Approaches and Teaching Techniques in Chemistry*'' (Taber, 2024) – drawing together his career long focus on thinking about the context of classroom practice. He really was a science teacher all along.

As a final word, I've selected this quote by Nancy Cartwright from Keith's collection:

''On the Day of Judgement, when all laws are known, these may suffice to explain all phenomena. But in the meantime we do give explanations; and it is the job of science to tell us what kinds of explanations are admissible.''

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