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The nature and scope of chemistry education as a field

It is sometimes suggested that academic fields become defined through their peer-reviewed journals: the presence of the journals is an acknowledgement of the existence of a field, and the journals act as gate-keepers to determine what is considered work that both falls within the scope of the field and reaches the standards expected in the field. The physicist-cum-historian Thomas Kuhn (1996) argued for the central importance of the scientific community in establishing, maintaining and communicating the standards within a field. Kuhn referred to scientists working within a paradigm or 'disciplinary matrix', into which they were apprenticed through their scientific training. Kuhn's ideas were based on his historical studies of developments in the natural sciences, and especially physics, but his notion of the work of academics being paradigm-led, i.e. channeled by the commitments and standards established as norms of a field, has been seen to have much wider significance.

Given the existence of peer-reviewed research journals in chemistry education, one might wonder whether chemistry education should be seen as an academic field in its own right, and whether there should be considered a discrete chemical education research community. If so, it is certainly something of a heterogeneous community. I suspect that some authors of contributions to this journal primarily see themselves as chemistry educators, others as research chemists, others as chemistry teachers, some as science educators...and still others primarily as something else entirely - psychologists for instance.

I sense it is becoming increasingly possible in some national contexts for academics in university chemistry departments to make educational work the main focus of their research efforts. However, most of those actively working in chemical education research within chemistry departments see themselves as primarily chemists and chemistry academics who undertake research into various disciplinary aspects of chemistry, *and also* undertake research into their teaching and their students' learning. Other researchers in the field are chemistry teachers at school or college level, who are exploring aspects of teaching and learning in their particular professional contexts. Other academics, especially those based in faculties of education rather than chemistry, may see themselves as primarily working in the field of education, and have a specialism within education relating to chemistry education. Indeed, some may work on various educational topics, and only seek to publish in a specialist chemistry education journal where the focus of a particular study makes this appropriate.

In this context, as well as considering how chemistry education relates to education more widely, there is the question of whether chemistry education as a field (or sub-field perhaps) is distinct from science education in any essential way, rather than simply being a subdivision of this larger concern. Such issues probably do not seem of particular importance to most readers of the journal, but I think it is right that editors give them some thought. If peer-review plays an important part in the development of a field, by deciding what is and is not classed as on-topic and of quality, then editorial decisions can be influential. One obvious example concerns who acts as a peer reviewer. In the case of the present journal, a valid question might be whether all peer-reviewers should be chemistry educators, or at least active in research in chemical education, or whether sometimes the evaluation of a submission requires specialist expertise from beyond the immediate chemical education community. My own view is that the latter situation does occur, although I expect most of the peer reviewing for the journal to be undertaken by those who do publish work on chemical education.

A related issue is what counts as chemical education. Many submissions to journals are 'screened' by editors and rejected before ever being sent for peer review. Sometimes this is because of a clear lack of quality, so that reviewers are only asked to commit their time to evaluating a submission when it offers at least a *prima facie* case for meeting quality criteria - an issue discussed in a previous editorial (Taber, 2012). However, perhaps surprisingly, many submissions are also rejected because they are considered to be outside the scope of the journal. This suggests either that (i) some authors submit to journals without ever reading the journal description or accessing the title and taking a quick look at the kind of work published; or perhaps (ii) it is not obvious from

a cursory familiarity exactly what would be considered within the scope of a particular journal. That is, if the community defines the field, and does so in part through the peer-review process, then it may not be obvious to outsiders or new researchers precisely what is considered to fall within the field.

I consider the responsibility of acting as steward for Chemistry Education by facilitating the peer review process (by inviting referees, and respecting their essential contribution by not asking them to evaluate clearly unsuitable or off-topic papers) to be a serious and important one. Luckily I am well supported by an Editorial Board and Advisory Board offering breadth of experience and available for advice when needed. I have declined a number of submissions that were clearly about chemistry, but had no substantive educational theme. Perhaps these authors are parsing the journal title in a non-canonical way ('Chemistry – Education; Research; and Practice?'), or perhaps they see the function of the journal as to inform Chemistry Education through new subject knowledge, rather than to recognise (and arguably legitimise) and disseminate new knowledge in the field of Chemistry Education itself.

Interestingly, perhaps, I do not think I have yet seen a submission to *Chemistry Education Research and Practice* where I felt the manuscript would be suitable for a more general science education journal, but did *not* belong in a chemistry education journal. This raises the question of whether there is any specific characteristic inherent in chemistry education that marks it out as a particular field of study, besides the obvious one that the work is carried out in the context of the teaching and learning of chemistry. Chemistry as a discipline certainly seems to have a particular character among the sciences, so perhaps we might expect to find chemical education also has its own personality. My personal hunch for a good candidate here might be the particular nature and roles of models in the chemical sciences, which perhaps we might expect to be reflected in teaching and learning the subject (Taber, 2010).

That might be considered speculation. Certainly the reader of the current issue of the journal will find considerable variety in the work reported. The studies describe work carried out at different educational levels, with participants varying from school children to post-doctoral chemists, most seen as learners, some as 'experts'. Pre-service and in-service teachers also participate. The chemical context varies considerably. In some cases the context is tied very specifically to the research questions, but in others simply provides a suitable learning context for approaching a specific research focus.

A wide range of theoretical foci and perspectives are drawn upon in the articles in this issue, so the reader will find work informed by ideas about, inter alia, cognitive processing and skills, conceptual change, constructivism, cooperative learning, heuristic strategies, individual differences, learning difficulties, learner understanding, modes of reasoning, motivational orientations, problem-solving, symbolic forms, teacher beliefs and visual literacy. That this list is gleaned from just this one issue of the journal undermines both how challenging chemistry teaching is, and what an exciting field of research and scholarship chemistry education has become.

In exploring such a range of themes, the authors of the contributions here draw upon a wide range of research methods. So data are collected by surveys and tests, various kinds of interview, and observations. The data analysis is similarly broad, with some papers adopting specific statistical techniques, and others relying on in-depth interpretive approaches. The number of participants enrolled in the different studies reflects this variation, with some papers reporting what is typical among samples, and others offering examples from the specific speech or inscriptions of individual learners. If Kuhn's notion of a disciplinary matrix suggests that each field has its own particular conceptual foci and theoretical perspectives, its own preferred methodological approaches and specific research techniques, then this diversity within chemistry education research might seem to bring into question its claim to be a research field. However all the contributions to this issue do have something very important in common: they are all concerned with the learning of chemistry, and informing the development of pedagogy for teaching the subject.

Teaching and learning are complex activities, and inevitably we need a wide range of studies to address different aspects of chemistry education. Ultimately the biggest challenge to our field is to build synthetic models of chemistry learning that can inform teaching approaches able to accommodate the important insights from so many varied lines of research. If that is ever going to be possible, it is very important that those working on different aspects of the project remain aware of, and informed by, each other's contributions. If journals define fields, then *Chemistry Education Research and Practice* has a major role to play here. From this perspective we should celebrate the variety of work in the journal. This present issue, then, with its breadth of studies reported, actually reflects something quite important about chemistry education as a field: its diverse nature and the wide scope of its theoretical considerations.

References

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