COMMENTARY

Is research mandatory for teaching undergraduate chemistry?

Lakshmy Ravishankar, Savita Ladage and Gomathi Shridhar

In the Sixth Pay Commission, considerable weightage has been given to research component in calculation of the academic performance index of a teacher. How feasible is it for an undergraduate (UG) chemistry teacher to do quality research with the existing workload and infrastructure prevalent in colleges? Is the quality of teaching chemistry in UG colleges improve by doing research? These are a few questions which will be addressed in this note. Plausible suggestions to strike a balance between teaching and research are also highlighted.

How important is research in qualifying as a good teacher in undergraduate (UG) education? With the introduction of the academic performance index (API) system by UGC, New Delhi for promotion of faculty in the Sixth Pay Commission, research has suddenly become the buzzword. Faculty members are now taking up some research project or the other and trying to publish papers so as to get the required points which make them eligible to apply for the next scale. What has been the outcome of this mad rush?

(i) Proliferation of many substandard journals which claim to publish articles in a week's time, albeit on payment of the required fees. Many teachers are willing to pay the necessary amount as it will add points to their API score. For the publishers, needless to say, they get articles and the money, which ensures that the journal (print or on-line) is sustained.

(ii) A rat race in colleges/institutions, with colleagues becoming secretive and wary of sharing information about upcoming conferences and their so-called research.

(iii) While research in interdisciplinary areas is welcome, however, we now have science teachers presenting papers in humanities and social sciences, without doing any studies, and presentations are done only for the sake of claiming points.

(iv) Many institutions have suddenly started hosting national and international conferences without giving any thought about their goal and/or purpose. Thus, very often, the themes are monotonous and repetitive. The same is true about the speakers as well. Often, participation in these conferences is not mandatory, as such conferences entitle a presenter to send his/her poster that would be displayed and the certificate would be provided.

(v) Often proceedings of the conference are published as a book and points for publication are included in the API by the authors/editors. While the individual articles for the publication of the proceedings are provided by the speakers/participants, the editor's role is to just put them in order and format the articles to maintain uniformity. More often than not, the editors are not involved in the research nor do they provide any scholarly inputs. However, such compilation of articles fetches the necessary points for the editors, under the research category.

According to the Sixth Pay Commission recommendations, in order to be eligible for promotion under the Career Advancement Scheme (CAS) of UGC from Associate Professor to Professor, one should have 40 points per year (category III, i.e. research and publications) and 120 points in the assessment period for internal promotion. These 40 points need to be obtained by presenting papers in conferences, publications, writing books/book chapters, guiding projects, etc. It implies that on an average, it is necessary to bring two publications per year in a good journal with moderate to high impact factor. With the workload of nearly 20–22 h per week and moderate research facilities (that may or may not exist), the question arises: 'is it an achievable target'?

While UGC provides financial assistance for minor and major research projects, a large time gap exists between submission of the project and declaration of results of the sanctioned projects. Starting a research project, in anticipation of funding, is a risk which many teachers do not wish to take. Participation in conferences abroad requires funding and all the funding agencies provide financial assistance to a teacher only once in three years. Often, the sanction of funding is notified only after the conference is over. As a result, many teachers find it difficult to go abroad and present papers.

In the midst of all this, few questions need to be seriously addressed: (a) Is only research in different areas of chemistry are considered or rewarded in the API? (b) If research is conducted in areas related to chemistry education which is relevant for UG teaching and learning, can it be considered for API points? (c) Can innovative efforts which enhance conceptual learning of chemistry be acknowledged in the API system?

In our opinion, while teaching and research complement each other, one is not mandatory for the other. With existing ground realities in the UG colleges, often it is not possible to take up research that is at par with that done in good scientific institutions. At the UG level, it is necessary to teach chemistry so that students are exposed to the frontier developments along with basic concepts. With such efforts, students will start perceiving chemistry as a vibrant and challenging domain, which will motivate them to pursue it further. If any teacher is putting in substantial efforts to do so, it is essential that it is acknowledged.

Several studies have been done on whether faculty research really enhances UG teaching[1]. Most of these studies relate to the engineering faculty abroad. However, some of the arguments proposed apply well to the Indian scenario, especially for the conventional B Sc programme. Rugarcia[2] and Felder[3] suggest that the objectives of research and teaching are different. While research involves discovery of new knowledge, teaching requires communication of existing knowledge effectively to a student. The main aim of teaching is to equip the students with environment/opportunities that enhance independent thinking and problem-solving. We understand that if a teacher is well-informed about the

developments in frontier research areas, she/he will be able to share such knowledge with the students. In fact, Felder[3] clearly mentions that forcing all professors to be researchers affects both the quality of teaching as well as research. Both research and teaching require a great degree of passion, and both involve full concentration. Doing both simultaneously would necessarily imply cutting down time on one to accommodate the other. Petrella and Jung[4] highlight the benefits of doing research and the positive influence it has had on the students as well as the mentors and institutions. There is no doubt that doing research enhances the analytical skills of the students, improves their writing skills and helps them to find solutions to problems, besides developing lab skills and independent thinking. In the US, there are national conferences held for UG research which provide students an opportunity to present their work. Also, there are special funding agencies which give grants specifically for UG research. Such involvements particularly help students to change their outlook towards a subject.

Let us now reflect upon the Indian situation. We strongly feel that by introducing an element of research in the UG laboratory, opportunities can be generated where students are planning an experiment, collecting data, interpreting it, etc. without resorting to cookbook recipes[5]. With such efforts, students can develop logical and analytical skills. Such innovative efforts, that often needs understanding of learning process, falls in the domain of chemistry education. They do not fit in the conventional and established research areas of Organic/Inorganic/Physical/Biochemistry/Material Science or Applied Chemistry and hence are often not appreciated and included in the domain of research in the Indian context. As a result, perhaps, motivated teachers who may be interested in such innovations will give up and join the rat race that fetches points under the API system.

In recent years, various new institutions where research is integrated with the UG curricula have been set up in the country. These institutions have excellent facilities for doing research. For initiating quality research that has involvement of teachers from regular colleges, is it not possible to start collaboration among these institutions and/or other scientific institutions with faculty from nearby local colleges? Exceptionally motivated and brilliant students from local colleges could also be provided opportunities to work in these research laboratories during vacation; this would motivate them to take up chemistry research. Such interactions will help researchers and teachers, who otherwise do not get opportunities to interact, particularly in the Indian context. With understanding of the existing realities, both stakeholders can proactively work towards development of research domains feasible in the regular colleges. Further, guidance can be given to motivated teachers about how to write proposals so as to get research grants from agencies like DST, CSIR, etc. Through such collaborations, it will be possible to develop some research areas in regular colleges and then the advanced work can be carried out in larger scientific institutions. We know that this is not the best option as opportunities will be open only to a limited number of students, but it is necessary.

The crucial change that is required is to introduce an element of research as part of the laboratory curricula. In our opinion, the interactions of researchers and teachers can be harnessed fruitfully to develop this domain and further projects can be worked out for students at the postgraduate (PG) level. If students at the UG level go through the different processes that are important for any kind of research work, then they will be better equipped to do research at the PG or higher level. Another important stakeholder is chemical industries, which can help develop instrumentation facilities at colleges and can interact with students and teachers. Such interactions expose students to chemistry at the industrial level and is yet another way of sustaining their interest. Industries could provide summer internships to motivated students to work in their research laboratories to get hands-on experience. Most of the students are capable of doing well, provided the required environment is provided. All such efforts will provide a support system that is needed for motivated teachers and students.

There are motivated teachers from regular colleges who are fighting against many odds and are still able to do good work which does not fall under the conventional research domain. There is a need to appreciate and acknowledge such efforts if we are serious about teaching–learning, particularly in regular colleges. Sadly, in the process of evaluation of a teacher, weightage for excellence in teaching seems to be completely ignored. Emphasis is given to the number of lectures taken, co-curricular activities, administrative activities in universities and colleges, and the number of papers published. Using such a yardstick, good teachers who are passionate about teaching can never qualify for promotion under the CAS system.

We believe that the domain of research defined for teachers should be made more inclusive – it should include innovative efforts that enhance the learning process. Thus, teachers must have the freedom to pursue efforts that boost learning (including research in chemistry education) and/or research that is feasible with infrastructure facilities or through collaboration with researchers from scientific institutions. Using a yardstick based on realities that exist in leading scientific institutions with excellent facilities and thrusting it on teachers in regular colleges is causing damage rather than bringing anticipated changes.

1. Prince, M. J., Felder, R. M. and Brent, R., *J. Eng. Educ.*, 2007, **96**, 283–294.
2. Rugarcia, A., *Eng. Educ.*, 1991, **81**, 20–22.
3. Felder, R. M., *J. Eng. Educ.*, 1994, **83**, 105–110.
4. Petrella, J. K. and Jung, A. P., *Int. J. Exerc. Sci.*, 2008, **1**, 91–95.
5. Ladage, S. and Ravishankar, L., *Curr. Sci.*, 2013, **104**(10), 1269–1270.

Lakshmy Ravishankar is in the Department of Chemistry, V.G. Vaze College of Arts, Science and Commerce, Mithagar Road, Mulund (East), Mumbai 400 081, India; Savita Ladage is in the Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, V.N. Purav Marg, Mumbai 400 088, India; Gomathi Shridhar is in the Department of Chemistry, V.K. Krishna Menon College of Science and Commerce, Bhandup, Mumbai 400 042, India.*
**e-mail: lakshravi@yahoo.com*