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The Importance of Advisory Boards in Undergraduate Chemistry Teaching

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Abstract: This paper investigates the usefulness of advisory boards from the perspective of a University Chemistry Department. It is shown that the impact of secondary school teachers on the Teaching Advisory Board contributes positively to maintaining congruence between post-16 pre-university courses and first year undergraduate courses. Several examples are provided where this board has provided valuable direction to the teaching at year 1. For a Chemistry (Science) department it is also important to have an Industrial Advisory Board populated with active industrialists. This board contributes towards the later stages of the degree programme and ensures that graduates are well prepared for employment. A newer advisory board, borne out of the creation of a Centre for Excellence in Teaching and Learning shows how a diverse group can also be an effective advisory board. The key element for success is having well defined terms of reference and clear objectives.

Key words: industrial, teaching, advisory board, consultation, school-university transition

Introduction

Kenny [1] outlines the very great potential benefits offered to any organisation by a well functioning advisory board. There are myriad possible ways that an advisory board can help an organisation from providing new expertise, information and contacts, to acting as a critical friend. However, there are two important factors that are paramount to ensuring a successful and well functioning advisory board; both are obvious but often overlooked. First, there needs to be clear terms of reference for the advisory board, i.e. what is its role and objectives. Second, the composition of the advisory board must be carefully chosen to realise the objectives [2]. Isaacson et al. (1994) discuss the importance of a scientific advisory board in the context of business but the principles translate perfectly well into the academic arena. Although industrial advisory boards in academia are now common place in Engineering and Science Faculties [3,4] it would appear that teaching advisory boards are less common or that little has been reported about them. There are indeed sizeable barriers to establishing an advisory board such as the expense (time and financial) of organising and holding such meetings and convincing appropriate candidates to become board members, convincing academic colleagues that a board is a profitable investment. Sadly, there are many people who have experiences of ineffective advisory boards and this builds up antagonism towards these structures. In this article we describe the role and effectiveness of three advisory boards that operate within the School of Chemistry at the University of Bristol. These are the teaching advisory board, the industrial advisory board and the advisory board for Bristol ChemLabS [5]. We will concentrate on the first and third that focus on teaching.

1. The teaching advisory board

In previous articles [6,7] we have discussed the impact of a School Teacher Fellow on a range of activities within a Science department. In many cases financial constraints mean that it is not possible

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for a department to employ a School Teacher Fellow, how then can it review its teaching practice? One way is to establish a teaching advisory board (TAB). There are several examples of a teaching advisory board that we know of in Physical Sciences in the UK and each has its own particular set of objectives and structure. Some contain only members from their own institution, and may involve members from allied disciplines as well as ones that are totally unrelated to their subject. In addition, they may also contain members that represent support services. Very few teaching advisory boards, if any, contain members from outside the institution. This lack of outside involvement may be because every department in Physical Sciences in the UK is likely to have at least one external examiner reviewing the examination process each year and in many cases institutions appoint a panel to review courses on a regular basis. However, in only a few cases are secondary school teacher's part of any teaching advisory board. We have a TAB that is composed of equal numbers of secondary school teachers (representing as wide a range of schools and examination boards as possible) and academics from the department, eight each. Prior to the Bristol ChemLabS project this advisory board met twice a year and now that we have a full time School Teacher Fellow, it is only necessary to meet just once a year for an afternoon. More than two meetings a year proved to be too difficult for the teachers to attend and meeting in the afternoon allows teachers to travel during the morning.

Examples of how the TAB influenced the chemistry curriculum at Bristol.

The broad objective of the TAB is to ensure that there is congruence between chemistry teaching at year 13 at secondary school (final year pre-university students at secondary school) and the first year of undergraduate studies.

For each meeting a particular topic of relevance to undergraduate teaching is chosen and a presentation from an academic and a secondary school teacher are given followed by an informal discussion. Much emphasis has been placed on the school to university transition and how the many changes to the secondary school schemes of work at General Certificate of Education (GCSE)[5] and Advanced (A)[6] level in the UK will impact on tertiary education. Topics that have been covered in the recent past include;

- Practical skills that students develop at A level and how this should shape first year undergraduate practical chemistry classes. This meeting was the start of a fundamental change in the way we approached practical teaching in chemistry and led to the establishment of Bristol ChemLabS a multimillion pound project [5].
- IT competency at secondary school, which included a demonstration of effective use of interactive white boards (IWB) in secondary schools. This meeting was the impetus to install IWBs in the School of Chemistry. A TAB meeting showing examples of school students' IT within chemistry resulted in the removal of a compulsory word processing course in Year 2 as the majority of school students were already competent. An on-line and Chemistry specific word processing and spread sheeting IT course was developed to support students that had not been through UK schooling or who simply needed to refresh their memory of the ways in which a science report should be formatted. This animated tutorial is available to all Bristol Chemists as part of the Dynamic Laboratory Manual (DLM).
- Mathematical competency required for degree level chemistry is a topic much discussed by university chemistry teaching staff. The TAB meeting focusing on this was part of a larger survey that assessed what a GCSE qualification in Mathematics really meant in terms of competency in the mathematical skills required by undergraduate chemist in the UK [8]. This meeting was part of a series of meetings that has led to the School of Chemistry raising its entry requirements from a C at GCSE to a top level pass at A level in Mathematics from October 2011.

[5] The GCSE is a UK national qualification for 16 year olds at the end of compulsory education.
[6] A Level is the 'gold standard' of the several pre-university examination systems. It is taken by the majority of students wishing to enter universities in England and Wales.

- Another meeting looked carefully at assessment methods at secondary school and how these compare with first year undergraduate assessment. Discussion of the way various elements are assessed in both secondary and tertiary education were highlighted, in particular, in written examinations how questions are presented and worded differently at undergraduate level and this has led to a refocusing of university tutorials and other support structures for undergraduates to aid the students with this transition.
- Recently at a TAB meeting it looked at new innovations in school science qualifications such as the Science Diploma [9]. Although this is something that is to be introduced in the UK in 2012 the meeting allowed us to discuss what the diploma might look like, what skills and competencies it would yield and how we might prepare at University to accept students with this qualification. In other words the School of Chemistry was looking proactively at this rather than the more normal university stance of behaving reactively. Decisions as to the appropriateness and acceptability of the highest level of entry of this course in consideration of application to Bristol's Chemistry degree courses have now been formulated.
- We have also discussed public engagement and how the School of Chemistry can support science teaching at secondary level. Many of the ideas have been incorporated into the portfolio of outreach activities that have been discussed elsewhere [10-14].

The TAB has a very specific role which its membership can very ably address. A body of school teachers acting in this way has been very profitable to the School of Chemistry, particularly with the many changes at pre-university level courses in the last decade.

In the UK the A level changes considerably in both content, optional modules availability (currently there are no options available) and how the courses are assessed. The latter does not just affect the number, type and structure of the externally assessed examinations but also the requirements on the internally assessed practical skills. The experience of current first year undergraduates in terms of knowledge, assessment experiences and the support that school students receive in the latter needs to be understood within the university system. In the UK roughly two thirds of the content of A level courses produced by the examination boards is common for any first year cohort of students. What is assumed to have been taught by university lecturers from one year to the next and even within a year is not necessarily what the students have experienced. An examination system within a university that has been suitable for students for decades that does not take into account the examination skills of the current cohort does the students a disservice. The TAB meetings can highlight these changes.

Future meetings will discuss Fresher's Week and the run up to starting University. 'Fresher's Week' is the name given to the first week of activities that first year undergraduates experience on coming to university. We will be discussing what we can do to make the start to University as positive an experience as possible for our young chemists.

What's in it for the secondary school teachers? Each meeting provides them with a valuable insight into the workings of a University department and also helps to shape their teaching at A level, in terms of preparing students for University entry. The networking opportunity also has other spin-offs such as access to equipment, advice, information and even to access academics to be visiting speakers.

2. Industrial advisory board

Another advisory board that operates in the School of Chemistry is the Industrial Advisory Board (IAB). It is similar to the TAB in structure (eight academics and eight industrialists) but has a different remit. In part the IAB is tasked with keeping the School of Chemistry up to date with the needs of industry, to ensure that graduates have the necessary skill sets that industry is looking for. Therefore there is scrutiny of the later stages of the degree courses in terms of content and practical skills.

When the complete replacement of all practical work was undertaken the IAB were consulted as to which practical and other skills the chemical industry wanted. These skills were then allocated to year groups starting with the basic skills in the first year, how these would develop in years 2 and 3 and which higher order skills were to be incorporated. The experiments were then designed to develop these skills. One consequence of all this was to remove the artificial borders of inorganic organic, and physical practicals (and to divorce the practicals from the lecture courses).

In addition, the IAB looks to build partnerships and to assist in the establishment of research centres of excellence. Most recently, the IAB has contributed to successful bids to establish Doctoral Training Centres for PhD students in Chemical synthesis and was an important component of the bid to become a CETL (see next section).

3. The Bristol ChemLabS advisory board

The Bristol ChemLabS project will be described in a forthcoming article in more detail and will only be briefly described here. In 2005 the Higher Education Funding Council for England set up 74 Centres for Excellence in Teaching and Learning (CETL) in England and the School of Chemistry at Bristol was the only one specializing in practical chemistry. The project was called Bristol ChemLabS (Bristol Chemical Laboratory Sciences) and has been a considerable undertaking. It has involved the total refurbishment of the teaching laboratory space and a number of innovations, including the development and implementation of a Dynamic Laboratory Manual (references [15,16] describe aspects of the Manual), an e-learning resource to support pre-laboratory preparation, a full time School Teacher Fellow [7,8] to advise on teaching at the School-University interface and to conduct public engagement, and a University Teacher Fellow whose role was to focus on developing new practicals for undergraduate teaching.

In order to run this project it was important to establish a variety of working groups which meet on a regular basis and who have a very clear and tightly defined remit. In addition both a management board which meets two times a year and an advisory board that meets once a year were established. The Management Board's role was to have an overview of the activity of the various working groups to ensure that they were on task. However, the advisory board has two main roles, first to hold the management board to account and to ask questions about how the project was run and to be a critical friend. Second, the advisory board has a remit to 'horizon scan', i.e. to bring advice and expertise to the project where needed, or to point the project towards outside groups or activities. In addition to Bristol ChemLabS staff (group 1), the Advisory Board consists of staff within the University who reside outside the School of Chemistry (group 2), as well as external members (group 3). Members from group 2 include

- The Dean of the Faculty of Science whose role is to run the whole of the Science Faculty. The Dean has been able to offer advice on funding opportunities and synergies with other departments.
- The Pro-Vice Chancellor for Education, whose job is to oversee Education across the whole of the University, has been able to advise and champion the spreading of best practice learned from the Bristol ChemLabS project to other parts of the University.
- The Head of the Education Support Unit in the University has also been able to work with the Pro-Vice Chancellor for Education to spread best practice but has been invaluable in helping the team to complete reports and to provide support in areas such as assessment and evaluation.
- The University IT unit is also represented and this has been helpful in practical issues such as equipment compatibility.
- The Head of the other CETL at Bristol in Medical Sciences called AIMS (Applied and Integrated Medical Sciences) [17]. A very close synergy has existed between the two CETLs and this has led to important economies of scale in terms of operation.
- Student representatives have been invaluable to the advisory board. Both undergraduate and postgraduate students have contributed very important information regarding both the day to day running of the activity but have also provided suggestions for innovations within the project. They are of course an excellent sounding board.

Members from group 3 include;

- The Chairman of the Heads of Chemistry UK, who has provided excellent advice and support, in particular on how to disseminate best practice to UK Chemistry Departments.
- Head of Education from the Royal Society of Chemistry, who has been able to liaise with our learned society in the UK.
- A representative from the Physical Sciences Centre within the Higher Education Academy. They have been able to assist with evaluation and assessment and were extremely helpful when we were formulating the bid.
- An independent assessor from a UK Chemistry department has been able to provide impartial advice and enquiry regarding operations. They have also been able to provide independent assessment of the success of the project and to draw attention to areas for further improvement.
- Representatives from industry and the Society of Chemical Industries, who have advised on equipment purchase, sponsorship strategies and in raising the profile of the project.

Overall, the advisory board meetings have always been positive, in that they have enhanced the project. There are many examples of actions arising from these meetings that have benefitted the project as a whole. It is rare to assemble such a diverse group together and they have not only been loyal to the project over the five years of its initial phase, but the whole is clearly greater than the sum of its parts.

An example of the use of the advisory board is a report on the project by our external evaluator [18] following a week spent at the Centre observing. They noted that, ‘The most obvious point to an outside observer is the purposeful air and committed attitude of the students at all three levels. The labs were full and there was a buzz of expectancy and enthusiasm at each level.’

Conclusion

This paper does not advocate a proliferation of advisory boards. However, from the perspective of a University Chemistry department, having secondary school teachers advising on the School-University interface and industrialists advising on later stages of the degree course has been extremely beneficial to the operation of this large, successful department, which has advantages to the undergraduates and to academic staff alike.

These benefits include; that the graduating chemists have the practical skill set that the modern chemical industry and academic research demands. There is less repetition of IT and science coursework covered at secondary school. The transition from school to University is smoother and we are aware of issues that are coming up (proactive) rather than learning about them as they happen (reactive) through the presence of a TAB and School Teacher Fellow. The work of a personal tutor has been reduced because the students are better prepared to start undergraduate courses and have more focused support. The impact of the Bristol ChemLabS project on the teaching of practical Chemistry at Bristol has been the most significant item in teaching for the last twenty years. Without the TAB and IAB the original bid to become a CETL would have been markedly weaker and their advice in shaping the CETL as it was established was very significant.

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