# COLLABORATIVE AND ACTIVE eLEARNING: CONTRIBUTING, RANKING AND TAGGING WEB RESOURCES IN FIRST YEAR CHEMISTRY

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## ABSTRACT

To enhance peer-to-peer and student-to-educator collaboration and to promote active eLearning, students and educators are invited to contribute, tag and vote on web-based resources via an application hosted on the eLearning site. These resources are organised according to the topics in the syllabus and hence are available in a succinct, week-by-week format as well as by common tags and by contributor. The resources are also feed to social networking sites to act as external resource libraries and to promote a sense of community and shared learning amongst the large and diverse groups taking our first year chemistry units. By encouraging our learners to contribute in this way and by utilising the large numbers of students in a positive way, the project also seeks to provide a manageable and reliable way of sourcing checking and ranking the vast amount of existing and ever-growing resources on the web.

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## INTRODUCTION

Scientific knowledge expands at a rate far beyond the ability of educators to keep pace. The growth of the web as the primary repository for the scientific literature means that today's students and educators have instant access to incredible, almost limitless, amounts of information. The web is also home to many engaging and interactive pages to enhance and expand the educational experience both in and out of traditional classes. It is now common for educators to include video clips, online simulations and to embed content from other institutions in their courses. Keeping abreast with the overwhelming and ever growing pool of resources and information on the web is a challenge for both students and educators. Although finding resources has never been easier, it is crucial that both students *and* educators are able to filter and analyse search results to locate the most pedagogically effective material. With many thousands of new websites published each day, keeping teaching material up to date and relevant whilst ensuring quality is a daunting task.

Search engines and sites such as *Wikipedia* are the first places that many students look for information and explanations. Recent studies by Head and Eisenberg (2010) and Head (2007) suggest that students are almost as likely to turn to a search engine for information as to suggest course reading. These studies are consistent with anecdotal evidence that a majority of students use *Wikipedia* for background information, usually in combination with other resources (although the detailed statistics in these studies are likely to cause unease amongst teachers and librarians, it is probably fair to add that many academics, including the author, use a similar approach when they design course material or field questions to which they do not know the answers).

Most recently, the proliferation of mobile devices, such as smart phones and now tablets, has also led to students accessing the web during laboratory classes, tutorials and even lectures. Williams and Pence (2011) have recently suggested a number of ways in which smart phones, which are really quite powerful computers, open opportunities for new activities in the chemistry classroom. As well as being very difficult to enforce, moves to completely ban their use in class to avoid students being in a state of "continuous partial attention" (Rheingold, 2009) ignore potential benefits such as more individualised learning, greater ease of conducting research and more in-depth learning (Warshauer, 2007). These benefits are just those sought by educators wishing for active and engaged learners.

My own, anecdotal, experience in lectures is that many students are actually using their devices to search for clarification on material that is being presented. The tablet, including the iPad and Android devices, appear to have considerable potential for enhancing active learning and interactivity in science education. The University of Adelaide's decision to provide science students with an iPad reflects the particular suitability of these devices for higher education: they are light enough to bring to campus but have large enough screens and are sufficiently powerful to be useful. As the tablet market grows and if, as seems likely, more institutions provide their students with these devices, new ways of teaching and learning will no doubt develop. Providing activities which require the effective use of these devices will give students valuable learning skills: the "digital native" generation may have grown up using these devices but that does not mean they are good at using them to learn.

The institutional 'learning management system' (LMS) is, for many students, the primary interface with the university. It provides an efficient means of making documents, such as lecture notes and tutorial work, and other media, including videos and podcasts, available to enrolled students. The management of learning through provision of appropriate downloads is essentially *didactic eLearning*. For the most part, students simply consume the resources that we provide. Schulmeister (2002) has previously called the learning style dictated by the design of today's learning management systems as 'administered learning'. Of course, the LMS can also be used to host more engaging activities such as discussions, quizzes and simulations. This paper describes an approach to *active eLearning* using resource aggregation and collaborative filtering (Hammond, Hannay, Lund and Scott, 2005) to collect, review and contextualise useful web resources. In essence, students, lecturers and tutors contribute URLs and descriptions of websites they have found to a centralised list and then vote on their usefulness. Social tagging (Hume, Carson, Hodgen, & Glaser, 2006, and Barak, Carson, & Zoller, 2007) is a powerful way of organising information based on keywords. In this project, the keywords automatically include topic descriptors based on the syllabus, as well as those contributed by the students, to facilitate the useful convergence of the tags (Pind, 2005). The contributed resources are ordered by these tags and by votes cast by the students, lecturers and tutors.

A large number of students, around 2000 students in semester 1 and around 1800 students in semester 2, take first year Chemistry units at The University of Sydney. These students come from every faculty in the university and a large number of degree programs. This provides huge challenges for ensuring individualised learning and for the developing a sense of identity, both for the students in their transition to Higher Education, and for the discipline of Chemistry. As identified in Kift's Transition Pedagogy (Kift, 2009), it is important to embed active and collaborative learning in the first year curriculum and to maximise opportunities for peer-to-peer and student-teacher interaction.

Alongside the opportunity to contribute to each other's learning in a social way, students also have the chance to personalise course topics and make them more relevant by adding links to resources which they themselves have found interesting. Providing some sense of community for students, who mainly commute and then attend classes across a large campus, is also important for successful transition and for initiating and maintaining student engagement (Barkley, 2009). The project described in this paper seeks to do this using social tagging and associated social networking tools.

Alongside the increased involvement of students in their (e)Learning, this project seeks to provide convenient tools for the course educators to contribute resources. This enables current research topics and even primary literature to be embedded in our courses, which are taught in parallel by several lecturers and a group of tutors. Resources, previously added in a fairly ad-hoc manner, can be structured by tagging and by topic and are available to all streams of students. The resources contributed by educators are labelled as such and thus form the core of 'trusted' material for the students.

The project seeks to utilise "crowdsourcing" (Anderson, 2007) as a means of both engaging students and developing and accessing their information searching skills. It seeks to use the large and diverse nature of our student cohort as a *positive*: a cohort of this type allows and utilises a large network of people with the same goals to learn together. The students collaborate with each other and with us to find, aggregate, share and filter resources and to open these resources for all to use (Tapscott & Williams, 2010). The role of the academic in this model of education is to facilitate and guide the students rather than to dictate just what to read and use. Unlike a traditional learning object or an eLearning site locked down for an enrolled cohort of students, the resource grows and improves naturally over time.

## METHODS

In this project, web resources are aggregated for each unit of study. The resources are contributed by students and educators via a simple form available on the course LMS site. The resources are automatically labelled and organised using the week-by-week syllabus descriptors. Contributors can also add an additional, personalised description of each resource and a number of tags. These tags aid searching and organising of the resources.

Figure 1 shows the ‘contributed links’ page for week 1 of the Chemistry 1B (CHEM1102) unit. Students can advance to other weeks (and return to previous weeks) during the semester. By default, the LMS displays to the current week of the semester ensuring that the content is “just in time” and relevant. In week 1, the students are learning introductory organic chemistry and the page lists the topics in the syllabus for the week: (i) ‘Representations of Molecular Structure’ and (ii) ‘Alkanes’. For each topic, the contributed resources are listed. For each, the title of the page, a brief description of its content and tag used to categorise it are displayed. Resources contributed by the educators on the unit are displayed. When contributing resources, students are given the option of including their name (or nick name) for display.

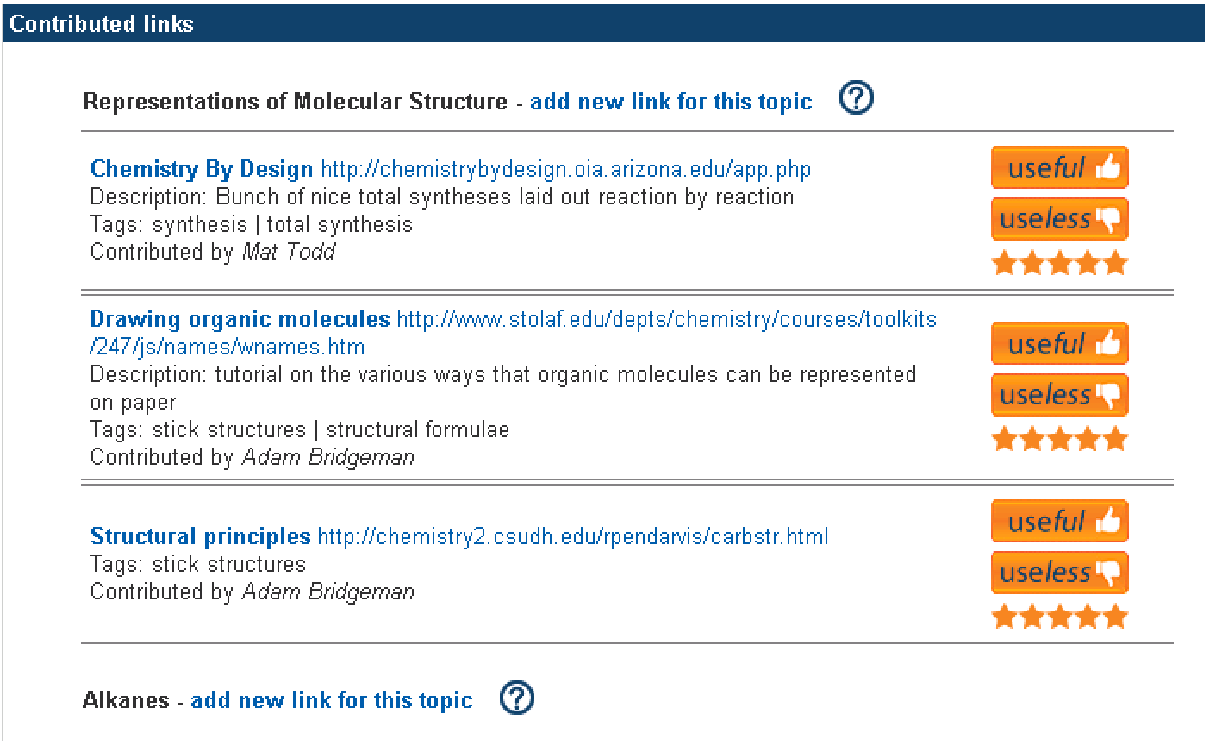


**Figure 1: Student interface for viewing, adding and ranking contributed resources**

The site is build on a data based driven website running on a server within the School of Chemistry using the Adobe Coldfusion platform. It uses an Access database to store the syllabus and contributed links. The pages are then embedded within our LMS (currently Blackboard Learn 9.1) using an iframe on a standard page. The functionality required for this site is not available within the LMS itself. This raises a potential issue of abuse as students are not required to separately log in to the contribute pages, and their identity is not passed. As the site is embedded within the LMS environment, this has not as yet been a real issue. Whilst it is important to be vigilant for abuse and for the submission of unreliable information, it would also be unfortunate to completely ignore the positives that result from encouraging students contributing in this way.

The system is introduced in a lecture with the lecturer advertising its availability and the reasons, outlined in the Introduction above, why students might want to contribute. The lecturer then introduces a favourite resource and shows how it can be added to the system. Any time during the subsequent course that the lecturer uses a web based resource, he or she then adds it to the database. As many – if not all academics – will use web resources, including the primary and secondary literature in designing the notes for a course, the system allows these links to be collected, maintained and organised.

To add a new resource, the user simply clicks on the link next to the appropriate topic (as shown in Figure 1). This brings up a pop up box, shown in Figure 2, which is modelled on those used on popular news aggregation sites such as Digg, Diigo and Delicious. It is designed to be quick and easy to use, requiring the user to input only a URL and a title for the resource that is to be contributed. The user can optionally add additional information such as a description, tags and his or her own name – or a nick name – to show who contributed the resource. Since, as described below, the quality of the links is maintained by collaborative filtering, the inclusion of a name is left to the discretion of the contributor. A slightly different interface is used by educators: inclusion of their name is required and they can also choose to further tag the resource as a simple informational website, an active learning simulation or as a self-learning tutorial. To ensure accurate classification of the resources, the syllabus heading is automatically included in the description given to the resource.

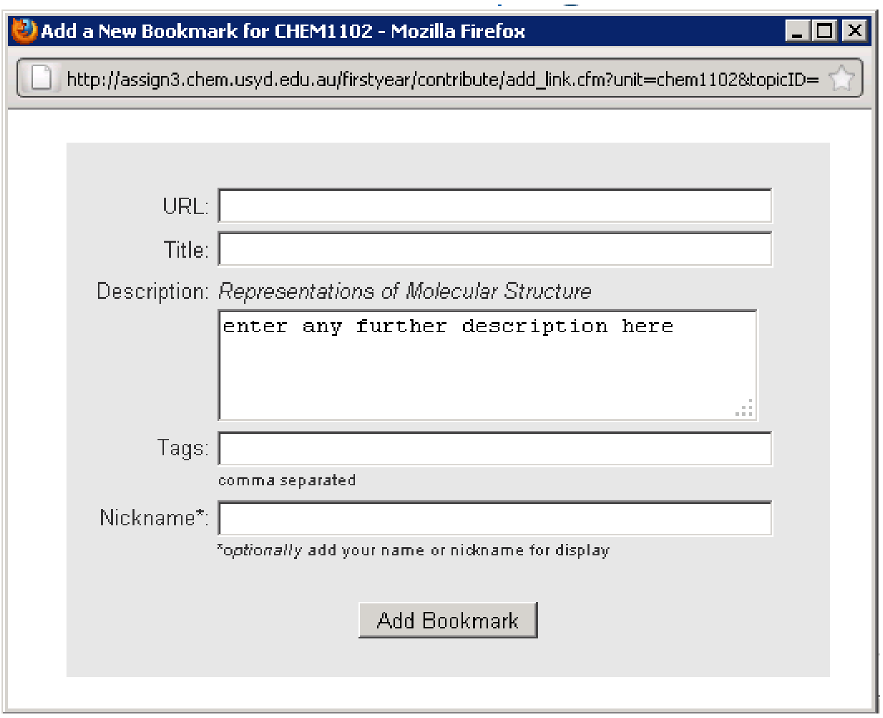


**Figure 2: Student interface for adding a new bookmark to the resource aggregation database**

The list of contributed resources for each topic is ordered according to how users rank them. Thus, the resources at the top of list are those deemed by the "crowd" to be those most useful whilst resources deemed poor naturally drift to the bottom of the list. It is envisaged that, as the database grows, resources in this category will be removed altogether. The ranking occurs via the "useful" and "useless" buttons next to the resource, as shown in Figure 1. Unlike sites such as Facebook which only feature a "like" button, a "useless" button has been included to catalyse rapid filtration of poor resources (or broken links). The number of positive and negative votes is combined to give a score out of 5 and this is displayed using a star system, shown in Figure 1, similar to that used in sites such as Amazon. This approach is analogous to the somewhat more sophisticated algorithms used so successfully by search engines such as Google and the news aggregation site Delicious (Jarvis, 2009).

By "harnessing the power of the crowd" (Carsten, Kerstin, Heng, Xiaohong, Liping, & Ruimin, 2008), resources can be rapidly contributed and filtered. However, the topics are necessarily technical and the "crowd" is a collection of learners. It is therefore important for the process to be guided or moderated, in similar ways to those used for discussion groups (Salmon, 2002; 2003). As outlined above, the resources are categorised and tagged according to the predefined syllabus. Within the closed community of the unit of study, the meaning of the syllabus descriptors is clear to all and is open to only limited interpretation.

It is also important for the lecturers and tutors to actively contribute and to be seen to be doing so. To ensure the visibility of the lecturers' and tutors' contributions, their names are required when resources are contributed and are displayed on the resources page, as shown in Figure 1. Resources contributed through the educators' portal are automatically ranked more highly. Votes cast to rank the resources by educators are also given higher credence than those cast by students. Currently, the algorithm simply weights contributions by educators (both resources and votes) 10 times higher than those from the learners. As the system evolves, this may change to ensure the right balance between encouraging active student participation and maintaining academic standards.

Although Jarvis (2009) outlines many successful examples from business, health and education, previous work reported by Carsten, Kerstin, Heng, Xiaohong, Liping and Ruimin (2008) suggest that additional incentives are required to promote engagement in the crowd-sourcing of educational resources. As noted above, we decided to make it optional for students to display their name for a link they have contributed. However, to try to encourage students to take part, and to motivate some to contribute repeatedly, the resources page also displays a list of the top contributors, as shown by the box in Figure 3. This shows a league table of the 'nick names' who have contributed the most links and links to a separate page, shown in Figure 4, displaying the actual links contributed. This latter page is, in effect, a collection of personal links.


**Figure 3: Top resource contributors**

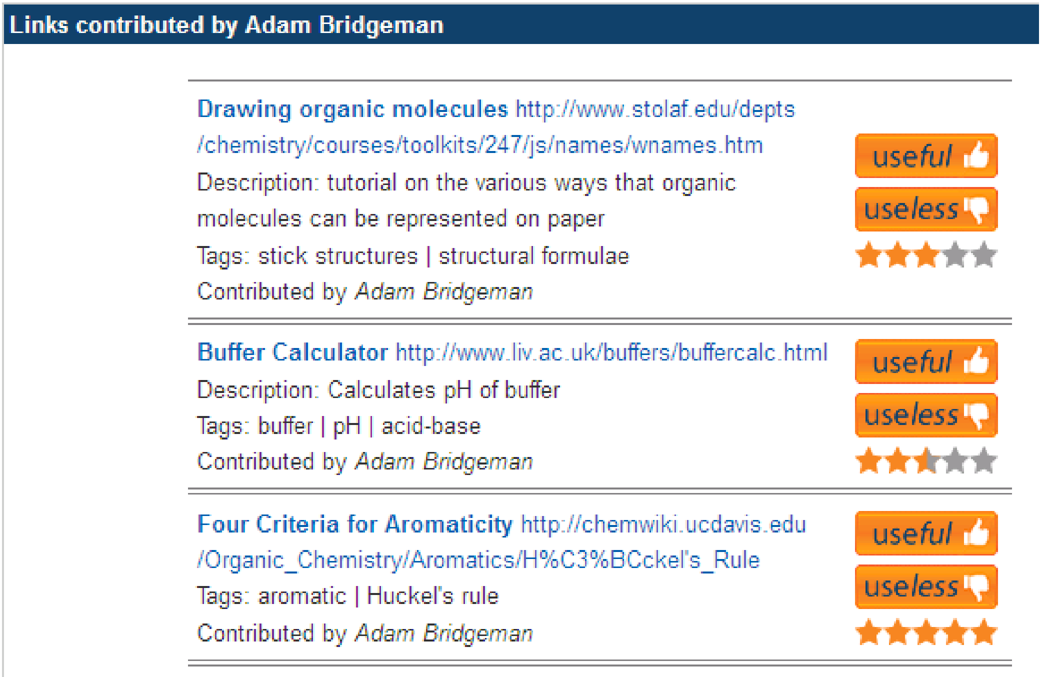


**Figure 4: Links contributed for a single person**

The standard list of contributed resources, shown in Figure 1, orders them by topic and delivers them automatically for each week of the semester. As outlined above, contributors also add their own tags to categorise the resources in a different, more personal, way. Figure 5 shows the most popular tags for the unit CHEM1102. The tags pick up the content of the resource in a slightly different, perhaps more student-centred way, than the syllabus list. It also allows resources to cross different weeks. Clicking on one on the links in the list leads to the corresponding resources, as shown in Figure 6.

| Top Tags | |
|---|---|
| stick structures | 12 |
| synthesis | 12 |
| total synthesis | 12 |
| structural formulae | 11 |

**Figure 5: Resources with the most popular tags**

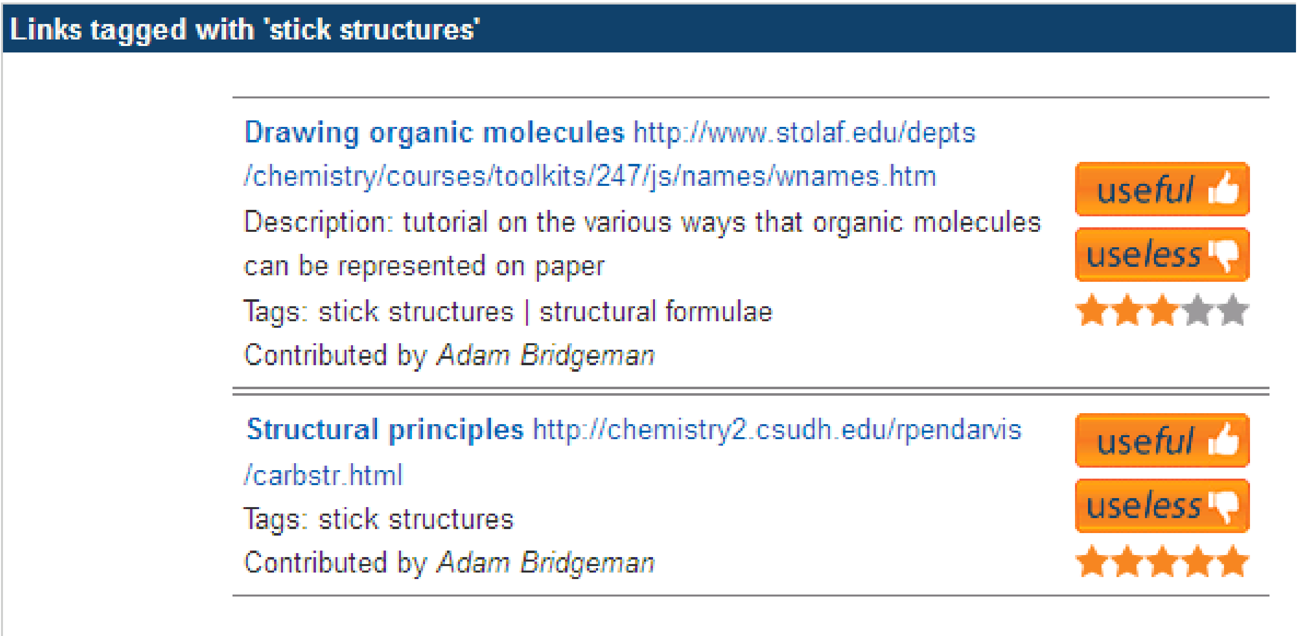


**Figure 6: Links sharing the common tag 'stick structures**

The contributed resources are available for students as an RSS feed. This enables them to download the list or to subscribe to it using their own news reader software. In this way, the links become a more permanent set of resources for a student and can be used or viewed in the way that they prefer. The RSS feed also automatically updates the unit's Twitter and Facebook pages as shown in the screenshots in Figures 7 and 8. These pages are also automatically updated with other notices, such as deadlines and course announcements, and links to other resources, such as lecture notes and tutorial worksheets. Students can choose to follow these pages if they wish to - reducing the barrier to engage with the unit even if a student does not actually directly contribute to the aggregation of resources. The social networking sites also allow the links to be more generally available as repositories of discipline and level specific resources. Students – are anyone else with an interest – can also use the voting and commenting facility in Facebook to further connect with the material.

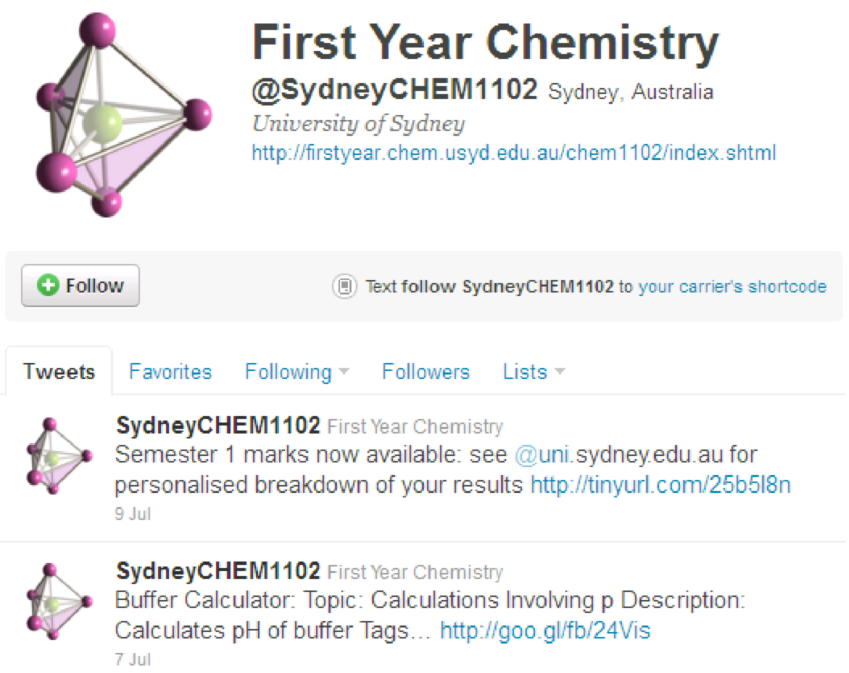


**Figure 7: Twitter site for CHEM1102 showing general notices and contributed resources**


**Figure 8: Facebook site for CHEM1102 showing general notices and contributed resources**

## CONCLUSIONS

The aim of this project is to break through the static nature of eLearning in our units and encourage more social and active learning amongst our student. To enhance peer-to-peer and student-to-educator collaboration and to promote active eLearning, students and educators are invited to contribute, tag and vote on web-based resources via an application hosted on the eLearning site. It is designed to be easy to use by both sets of contributors so that the barrier to contributing is small. Given the vast and ever-expanding amount of resources available on the web, the project seeks to provide a manageable and reliable way of sourcing checking and evaluating this content.

The aggregated resources are organised according to the topics in the syllabus and hence are available in a succinct, week-by-week format as well as by common tags and by contributor. The list of resources are openly available and are feed to social networking sites to act as external resource libraries and to promote a sense of community and shared learning amongst the large and diverse groups taking our first year chemistry units.

Although in its early days, the project has been well received by the educators and learners. It is anticipated that it will evolve and grow as users contribute and seek to use the data in new ways.

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