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Contributions of Ted Kuwana to Analytical Sciences Education

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Ted Kuwana has had a profound impact on analytical chemistry education. Initiatives he started back in the mid-1990s continue to be important today within the analytical educational community. In the mid-1990s, Ted was concerned about the quality of instruction in analytical chemistry courses. One reason for his concern arose from feedback from industrial analytical chemists who reported that many of their new hires did not have the skills most valued in industry. During that time period, it was common to have academic chemists claim “this is what chemical industries want” as justification for why quantitative analysis courses should include recipe-driven experiments involving lots of gravimetric analyses and titrations, and why instrumental analysis courses should have students cycle through a set of experiments involving a superficial introduction to every analytical instrument available to undergraduates in the department.

Ted is also someone who works to address issues that need attention. In this case, that involved Ted forming a steering committee composed of professors, industrial representatives and textbook authors, to discuss plans for improving instruction. Soon after, a special grant funded jointly by the National Science Foundation Division of Education and Division of Chemistry was obtained.[1] The grant funded a two-part workshop to examine the undergraduate analytical sciences curriculum and provide recommendations and implementation modes for improvements in the education and training of future analytical scientists. The workshops were attended by a broad range of representatives from academia, industry,

publishing firms, professional societies, government laboratories and the National Science Foundation. Ted’s stature as a respected researcher, scholar, innovator and mentor was critical to the success of the workshops. A report published in 1997 titled *Curricular Developments in the Analytical Sciences* [2] summarized the outcomes of the workshops. The primary recommendation, especially encouraged by industrial workshop participants, was that the undergraduate analytical sciences curriculum needed to engage students in problem-based experiences in the classroom and laboratory portion of courses. The use of lecturing and recipe-driven experiments was discouraged as these experiences do not provide meaningful engagement of students nor develop the skills most valued by graduate programs, professional schools and future employers of students with Bachelor’s degrees.

Ted also recognized that the published report was likely to gather dust on people’s bookshelves without systematic efforts to promote its recommendations. A new steering committee formed after publication of the report instituted a number of activities with this intent. One involved offering regular symposia within the Analytical Division at national meetings of the American Chemical Society featuring speakers who were using engaged student learning strategies in their analytical chemistry courses. Regular symposia of this nature continue through today. Another was to have regular education articles in the A-pages of *Analytical Chemistry*. Ted had made sure to involve Royce Murray, editor of

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Analytical Chemistry at that time, in the workshops. From 1999-2003, Tom Wenzel of Bates College was a Contributing Editor who wrote articles on educational topics and solicited articles from faculty members who were using engaged student learning methods in their courses. Regular half-day workshops or short courses on problem-based learning in the analytical sciences curriculum were organized at Pittcon from 1999-2006. Glenn Boutilier (Proctor and Gamble), Charles Hosten (Howard University), Jeanne Pemberton (University of Arizona), Tom Wenzel (Bates College) and George Wilson (University of Kansas) were the primary facilitators for the series of workshops.

Another outcome of the report was a suggestion to develop a digital library that provided resources and links to resources for instructors looking to incorporate problem-based learning into their lectures and laboratories. Perhaps one of the most notable of all the outcomes from Ted's educational activities is the *Analytical Sciences Digital Library* (ASDL) [3]. The ASDL was established in 2002 and was supported in the early years through grants from the National Science Foundation (NSF) under its national digital library initiative and Division of Undergraduate Education grant programs [4]. Funding continued for the development of active learning E-learning modules and both national and regional active learning workshops for faculty [5]. In 2005, Ted partnered with Chris Enke, chair of the American Chemical Society (ACS) Division of Analytical Chemistry, another prominent leader in analytical chemistry education and research. Chris recognized the impact of ASDL and a Memorandum Of Understanding was established with the ACS Division of Analytical Chemistry facilitating a partnership to promote and conduct educational outreach. The library continues to be supported through funding from the Analytical Division of ACS. All materials on ASDL are under the Creative Commons Copyright so are freely available to people throughout the world.

The library has a number of resources. ASDL is divided into four major sections: ASDL Collection, ASDL Community, Active Learning, and Remote Labs and Simulations.

The Collection contains a peer-reviewed catalog of freely available educational materials in nearly every area of analytical chemistry.[6] Most of the entries in the catalog include links to existing web-based material from industrial and academic entities. The materials are sorted by both technique and topic and include a synopsis of the content and how it might be used in the teaching and

learning of analytical chemistry. Ted's idea was to distill the thousands of hits for a particular topic from a general search engine query down to a manageable list of the most effective teaching materials.

Users will also find in the Collection a fully downloadable analytical chemistry textbook (*Analytical Chemistry 2.0*, by David Harvey) along with original textual and active learning materials produced for the site by analytical faculty as part of a number of ASDL Curriculum Development Workshops.[4c,5a] Ted was integral in organizing and leading many of these workshops.

Other sections of the library include ASDL Community, a forum for the sharing of user-generated content like data and problem sets, instructional videos, laboratory experiments and a repository for information on using the open-source statistical analysis package R.

In response to a dearth of active learning materials that limited the number of people adopting the methodologies recommended in Ted's *Curricular Developments in the Analytical Sciences*, spearheaded by Cindy Larive and Tom Wenzel, an Active Learning section of ASDL has been developed over the past decade.[7] Two grants were obtained from NSF that enabled additional curriculum development workshops with a team of about twenty analytical faculty representing a broad range of institutions to specifically produce active learning materials for the library.[5] The ASDL active learning site contains freely available peer-reviewed textual and active learning material developed by groups of faculty members at ASDL Curriculum Development workshops. This material is available as editable Powerpoint and Word files so instructors can download and edit for their courses. Ted was integral in organizing and leading many of these curriculum development workshops. Ted not only led the workshops, but also developed materials for the site, including an electrochemistry lab manual.[8] Ted took great pride in developing a community among the participants by organizing group dinners and activities. David Harvey of DePauw University articulated the feelings of many that attended these workshops: "For me, one of the significant outcomes of Ted's vision for the Analytical Sciences Digital Library was the series of annual summer workshops that brought together a community of analytical chemists interested in exploring pedagogy broadly and, more specifically, active learning. I think this was particularly important for faculty members at smaller, undergraduate institutions, such as myself, where one often is the sole analytical chemist. The opportunity to work collaboratively with faculty

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colleagues at other institutions to develop new pedagogical materials has been an essential part of my professional development for the past 15 years.” Anna Cavinato of Eastern Oregon University and Chair-Elect, ACS Division of Analytical Chemistry adds “I was fortunate to cross paths with Ted earlier on in my career. His innovative efforts to promote active learning not only helped shape my current teaching but also gave me the opportunity to connect with a small community of educators around the country. Because of Ted’s vision, that small community has now become a large reform movement affecting the teaching of analytical chemistry nationwide.”

A more recent grant from NSF has supported active learning workshops attended by more than 130 faculty members that emphasized the use of active learning and creation of materials for adoption in their classrooms and laboratories. The national workshops were followed up by regional workshops that showcased these new materials, and by an on-campus visit by a facilitator to observe a class or lab and to provide additional feedback. Nearly 200 class and laboratory exercises produced by these workshop attendees can now be found in the Active Learning section of ASDL. These materials are freely available with proper attribution, to any faculty with or without modification for use at their own institutions.

The last section of ASDL is the newest. Developed in response to the Covid-19 pandemic, the Remote Labs and Simulations section supplies both hands-on and simulated laboratory exercises that can be performed remotely. The exercises span the range from high school chemistry through general and analytical chemistry to instrumental analysis.

The educational advances highlighted here would likely not have happened without Ted’s efforts in the mid-1990s to bring together industrial and academic shareholders to discuss the undergraduate curriculum in the analytical sciences. Through these efforts, Ted has not only impacted the careers of many of his students but of countless faculty members and their students. In the words of Alex Scheeline Professor Emeritus, University of Illinois at Urbana-Champaign, “Ted was someone of vast perspective, practical insight, understated enthusiasm, and high standards. Not to mention he has excellent taste in restaurants. In some sense, ASDL served as his post-retirement research group. We faculty served the role of graduate students and post-docs. Ted is a man of impeccable integrity, a dedicated analytical electrochemist, and a savant who saw how to harness the internet to improve analytical education in a practical

way that anticipated the needs of the COVID era by 20 years.”

References

- [1] *Curricular Development Workshops in the Analytical Sciences*, Award number 9615091, August 29, 1996 – November 28, 2000. https://www.nsf.gov/awardsearch/showAward?AWD_ID=9615091 (accessed April 16, 2021)
- [2] https://www.asdlib.org/files/curricularDevelopment_report.pdf (accessed May 6, 2021)
- [3] <https://home.asdlib.org/> (accessed May 4, 2021)
- [4] a) *Analytical Sciences Digital Library*, Award number 0121518, October 1, 2001 – December 31, 2004. https://nsf.gov/awardsearch/showAward?AWD_ID=0121518&HistoricalAwards=false (accessed May 4, 2021) b) *Collaborative Project: Assessing the User-base and Expanding the Usability/Reach of the Analytical Sciences Digital Library through Developmental Workshops*, Award numbers 0531941 and 0435422, February 1, 2005 – September 30, 2010. https://nsf.gov/awardsearch/showAward?AWD_ID=0531941&HistoricalAwards=false and https://nsf.gov/awardsearch/showAward?AWD_ID=0435422&HistoricalAwards=false (accessed May 4, 2021) c) *Collaborative Research: Development of Contextual E-Learning Modules for Analytical Chemistry*, Award numbers 0817595 and 0816649, September 1, 2008 – August 31, 2011. https://nsf.gov/awardsearch/showAward?AWD_ID=0817595&HistoricalAwards=false (accessed May 4, 2021) d) *Incorporating an Internet-Mediated Community of Practice for the Analytical Sciences Into the Analytical Sciences Digital Library*, Award number 0937751, September 15, 2009 – August 31, 2013. https://nsf.gov/awardsearch/showAward?AWD_ID=0937751&HistoricalAwards=false (accessed May 4, 2021)
- [5] a) *Development of E-Learning Modules for Analytical Chemistry*, Award number 118600, September 1, 2011 – May 31, 2017. https://nsf.gov/awardsearch/showAward?AWD_ID=1118600&HistoricalAwards=false (accessed May 4, 2021) b) *Collaborative Research: Moving Faculty from Experimentation With to Long-term Adoption of Engaged Student Learning in Analytical Chemistry*, Award number 1624898, September 15, 2016 – June 30, 2021. https://nsf.gov/awardsearch/showAward?AWD_ID=1624898&HistoricalAwards=false (accessed May 4, 2021)
- [6] a) C. K. Larive, T. Kuwana, S. Chalk, Peer Reviewed: The Analytical Sciences Digital Library *Anal. Chem.* **2004**, 76, 399A-402A. b) T. E. Chrzastowski, A. Scheeline, The Analytical Sciences Digital Library Taking the Next Steps. *Science & Technology Libraries*, **2006**, 26, 79-94, DOI: [10.1300/J122v26n03_06](https://doi.org/10.1300/J122v26n03_06) c) C.K. Larive The Analytical Sciences Digital Library (ASDL). *Anal. Bioanal. Chem.*

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- 2009, 395, 2425-2419. <https://doi.org/10.1007/s00216-009-3226-6> d) R. S. Kelly, C. K. Larive, The Analytical Sciences Digital Library: Your Online Resource for Teaching Instrumentation. *J. Chem. Educ.* **2011**, 88, 375-377. DOI: 10.1021/ed101108t
- [7] a) <https://community.asdlib.org/activelearningmaterials/> (accessed 4/20/21) b) C. K. Larive, T. Kuwana, in *Active Learning* (Ed.: P.A. Mabrouk) ACS symposium series, vol 970, **2007**, pp. 188-198. DOI:10.1021/bk-2007-0970.ch014
- b) T. J. Wenzel, C. K. Larive, The Analytical Sciences Digital Library: a resource to promote active learning *Reviews in Analytical Chemistry*, 2014, 33, **2014**, 1-9. <https://doi.org/10.1515/revac-2013-0024>
- [8] Analytical Electrochemistry: A Laboratory Manual Dr. Ted Kuwana https://www.asdlib.org/onlineArticles/elabware/kuwanaEC_lab/ec_labmanual1.htm (accessed 4/20/21)