Book & Media Reviews

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Promoting Integrated and Transformative Assessment: A Deeper Focus on Student Learning

by Catherine M. Wehlburg

Jossey-Bass: San Francisco, CA, 2008. 224 pp.
ISBN: 978-0470261354 (cloth). $40

reviewed by Scott Smidt

Designing and Assessing Courses and Curricula: A Practical Guide, 3rd Edition

by Robert M. Diamond,

Jossey-Bass: San Francisco, CA, 2008. 512 pp.
ISBN: 978-0470261347 (paper). $45

reviewed by Scott Smidt

The Importance of Design and Assessment

Consider two scenarios.

In the first one, you are asked to teach a new class on short notice. You know the content well, so you grab a copy of the textbook and a calendar and efficiently produce a schedule of topics for the syllabus. You will write the exams and pick the homework problems later. What is so hard about course design?, you ask a colleague.

For the second scenario, imagine that the sequence of courses for the ACS-certified chemistry program at your school was established years ago. Since that time, faculty have come and gone and the ACS guidelines *(1)* have been revised. The next accreditation visit is coming up, and someone asks which class addresses the guidelines regarding team skills and ethics. Professor So-And-So used to deal with that in her classes, but she retired five years ago. Time to panic: Who is teaching that material now, and more importantly, were students ever really *learning* it?

The two books reviewed below address various aspects of these issues. By way of introduction, one sentence from each author will summarize the importance of each book. First, Robert M. Diamond on course and curriculum design: "Successful learning requires quality instructional design" (p 225). This is clear and to the point, but how will you know whether the instructional design is of the highest quality? Or whether students are actually *learning* what you expect them to? I'll let Catherine M. Wehlburg answer those questions: "[G]ood teaching requires knowing what students are learning, and to know what students are learning requires assessing them in some way" (p xii).

Promoting Integrated and Transformative Assessment

If hearing the word "assessment" makes you think only of accreditation visits, then Catherine Wehlburg's book, *Promoting Integrated and Transformative Assessment*, might be of interest to you.

As signaled by the book's title and as described by Wehlburg, campus-wide assessment programs should be *integrated* with what teachers are already doing in their classrooms (and also with planning and budgeting processes). And, such programs should be *transformative* in the sense that the results of assessment should guide improvements in course and curriculum design—to "close the assessment loop" (p 4), as Wehlburg writes.

For too long, claims Wehlburg, assessment has been driven by the need to demonstrate accountability to accrediting bodies instead of by a desire to continuously improve student learning. Although "assessment for accountability" is necessary, it should be secondary to "assessment for learning". According to Wehlburg, getting these priorities reversed warps the kind of data collected by assessment programs and is one cause of faculty resistance to campus-wide assessment. Because faculty see assessment through the lens of accountability rather than of learning, they often do not see any direct benefit of collecting assessment data or writing assessment reports. Much of the book deals with the relationship and the tension between these two purposes of assessment.

Those readers looking for lists of classroom assessment techniques will need to look elsewhere than Wehlburg's book. Her text is aimed primarily at departmental or campus-wide assessment issues. It does not deal with classroom assessment or assessment of individual courses (except for a general discussion about using existing course assessments to provide data for the departmental or campus-wide assessments). An additional warning is necessary: for those interested in a book providing a detailed program for implementing departmental or campus-wide assessment plans, they will not find it here. The book does provide advice regarding the campus climate and institutional dynamics necessary to move from assessment for accountability to assessment for learning, but it does not provide a step-by-step guide for reaching this goal.

So who will benefit most from reading this book? Faculty members who would like a brief, easy-to-read introduction to the potential benefits of a well thought out assessment plan; who are interested in moving their campus or department from an assessment program designed to show outside interests that everything is fine to one designed to detect how student learning can be improved; or who want to understand the increasing emphasis that accrediting bodies place on continuous quality improvement: all these will benefit from the book. Catherine Wehlburg, currently the director of the Office for Assessment and Quality Enhancement at Texas Christian University, serves as a worthy guide.

Designing and Assessing Courses and Curricula

Where Wehlburg's book is brief and general, the third edition of Robert Diamond's *Designing and Assessing Courses and Curricula* is the opposite. Where Wehlburg focuses primarily on campus-wide assessment, Diamond's book is geared toward the specifics of course and curriculum design.

The book begins with several chapters of background material dealing with general aspects of course and curriculum

design, the role of accreditation, and the importance of institutional recognition for faculty work on design projects. Much of this material could be considered optional reading. The second section of the book outlines the details of the author's systems theory model for instructional design. The first steps of the model involve collecting data (on students, their performance, the needs of employers, and more) to demonstrate a need for course or curriculum redesign and to provide baseline data for later comparisons. Such data collection is an important step that is often only implicit (at best) in many systems of course or curriculum design. After the initial data collection step, Diamond's model follows the same basic plan of most instructional design processes: setting goals, identifying learning outcomes, deciding on the evidence that outcomes have been met, creating the learning activities that will help students meet the outcomes, and evaluating what worked and what did not. The names given to the individual steps might change, but the process is familiar. The book's third section provides information and advice regarding course design, specifically, the selection of instructional techniques and materials to be used in the course. This section contains chapters on the use of technology, distance education, characteristics of adult learners, and the need to address student diversity.

One thing that makes Diamond's book different from other course design books is the information it provides about large-scale curriculum design projects. Clearly the author has a great deal of experience in this area, and his advice on how to manage all the competing interests will be useful to anyone undertaking such a project, whether revising the curriculum for a specific major or reworking a school's general education requirements. Diamond recommends which people should be consulted from the beginning (for example, did anyone think to invite the registrar?) and how meetings can be most productive. But this added information is a two-edged sword: I occasionally found it a bit distracting how the text switched from course-design information to curriculum-design information and back again. Someone interested only in course design (or only in curriculum design) might find a book dedicated to one or the other topic more useful. Having said that, it also would be possible for a reader simply to skip the parts that were irrelevant to his or her particular interests, as opposed to reading straight through for the purposes of writing a review.

Finally, Diamond's book includes an extensive appendix of resources (mostly excerpts from institutional reports and other publications) and case studies (details of course and curriculum design from other schools). The short, annotated bibliographies provided at the end of each chapter will also be useful to readers wanting up-to-date references. Although it may not demand a place on your shelf, Diamond's book is well worth examining before you begin any major projects in course or curriculum design.

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Whole-Class Inquiry: Creating Student-Centered Science Communities

by Dennis Smithenry and Joan Gallagher-Bolos

NSTA Press: Arlington, VA, 2009. 202 pp. 2 DVDs.
ISBN 978-1933531342 (paperback) $28.95

reviewed by Robert Mullins

If you have tried and failed at introducing inquiry-based learning in your classroom, or if you just want to begin, there is no better place to start than with *Whole-Class Inquiry: Creating Student-Centered Science Communities*. Dennis Smithenry and Joan Gallagher-Bolos have written a wonderful book that incorporates teaching strategies for actual teachers using scaffolding, demonstrations, and the implementation of whole-class inquiry. The lessons and strategies are flexible, set in reality, and can be accomplished in any classroom. This real-life look at student-centered inquiry classrooms is a great read. What is more, the accompanying DVDs will let you see and hear what an inquiry classroom looks like. I like the idea of an inquiry-based learning classroom, and I have tried to match that idea with the realities of my own classroom. However, student-centered inquiry learning never happened there in the way that the experts said it should. This book can help teachers turn the idea of inquiry-based learning into a concrete and effective reality.

Joan Gallagher-Bolos invites you into her real classroom with open arms. She reveals her plan for each lesson, and through DVD clips, she illustrates how inquiry happens in an actual classroom with real students. Gallagher-Bolos then reflects on the results of each lesson and how she handles the questions and frustrations of the students. Through this process of *teach, show, and reflect,* she leads the reader through a complete semester, demonstrating how to set up and perform the whole-class inquiry laboratories. She also monitors and presents the students' progress as they take charge of their learning while developing and working on their inquiry projects.

The DVD clips of Gallagher-Bolos's classroom lessons demonstrate that inquiry-based learning is based on three principles: accuracy, safety, and community. The principle of accuracy involves keeping the students focused on learning the chemistry behind the inquiry project. Safety is addressed as the students implement experiments and become aware not just of their own safety, but also of their classmates' safety. The students begin to police themselves on safety issues, such as wearing safety goggles. The concept of community (whole-class teamwork) is the key to the students taking ownership of their project and learning. Formerly introverted students break out of their comfort zones and participate in the development of the project and the presentation of the results. Students seek out other students for help in understanding chemistry concepts as they assume control of their learning and comprehension.

After each DVD segment, Gallagher-Bolos explains her thoughts and Dennis Smithenry explains the teaching strategies behind the implementation and development of the students' whole-class inquiry project. For example, teaching strategy #5 focuses on structuring the whole-class inquiry classroom environment. Smithenry provides a detailed analysis of Gallagher-Bolos' teaching strategy, and reinforces it through focused

analysis of the transcripts from the DVD. In the last few chapters of the book, Smithenry explains the results of his study about the implementation of the whole-class inquiry project in Gallagher-Bolos's classroom. He breaks down the whole-class inquiry project into structured models showing the timeline and phases of a typical project. He then discusses the impact of whole-class inquiry on student chemistry knowledge acquisition and students' perceptions of the whole-class inquiry experience and outcomes. Finally, he discusses how whole-class inquiry fits into the theory and practices of other current educational models.

With this book, Gallagher-Bolos and Smithenry have inspired me to take up the inquiry gauntlet once again. They have provided a thorough, well-structured format that can be easily followed or modified to suit any classroom and any teaching style.

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Multiple Solution Methods for Teaching Science in the Classroom: Improving Quantitative Problem Solving Using Dimensional Analysis and Proportional Reasoning

by Stephen DeMeo

Universal Publishers: Boca Raton, FL, 2008. 304 pp.
ISBN 978-1599429885; $29.95 (paper)

reviewed by James W. Jetter

Nearly all chemistry courses present concepts that require mathematical solutions. Most teachers, lecturers, and instructors know that mathematical problems are often the greatest challenge to chemistry content instruction. Stephen DeMeo's *Multiple Solution Methods for Teaching Science in the Classroom* provides a great resource for high school- and introductory-level chemistry course lesson planning that involves mathematical manipulation.

DeMeo focuses on how a teacher can improve quantitative problem-solving instruction through the use of dimensional analysis (DA) and proportional reasoning (PR). DA appears to be more commonly used than PR: an online search of this *Journal* found five DA articles *(1−5)* and no PR articles. Chapters 1 and 2 explore the algorithmic differences between DA and PR by solving a few simple problems. Chapter 3 focuses on DeMeo's survey of 1100 high school and college chemistry teachers to explore their attitudes about using DA or PR to solve science problems. In the survey, DeMeo gave the teachers a sample problem involving a limiting reactant and stoichiometry. The teachers overwhelmingly preferred DA to PR, and most teachers were either reluctant or unwilling to use more than one method for mathematical solution instruction. Chapter 4 discusses why DA is the dominant choice for instruction and what the literature reports when Piaget's developmental ideas are applied using either or both DA and PR learning.

I was taught to use DA to solve chemical problems involving mathematical reasoning. For this reason, I have always taught DA to my students. But Chapters 5 and 6 convinced me that using both methods can enhance student learning. In Chapter 5, DeMeo describes a study of two groups of chemistry students in a workshop at Hunter College. The workshop attendees generated an excellent and detailed decision map for solving stoichiometric problems. It is clear from the chapter that this was a wonderful learning experience for both teacher and students. Chapter 6 focuses on the reactions of nursing students when DeMeo asked them to choose between DA and PR to solve stoichiometry problems. He then compared the students' perspectives to those of the teachers who took part in his survey. Chapter 7 provides a literature survey about multiple-method instruction. The key point in this chapter (and the entire book) is that how well students learn the content matters more than the methods instructors use. DeMeo goes on to say that the literature suggests that using multiple methodologies enhances the student learning process.

Today's students are versed in multitasking. As a result, they can learn effectively through multiple-method instruction, which can in turn enhance the students' learning potential. Chapter 8 suggests how to improve the science education curriculum. In particular, DeMeo discusses how administrators can incorporate both DA and PR instruction in curricula from elementary school to high school. He illustrates this in Table 8.1, which provides a detailed integration plan. The end of the book has an appendix showing the results of the questionnaire discussed in Chapter 3. Finally, DeMeo provides a detailed list of references with brief descriptions. The book does not contain an index, which would have been helpful.

Multiple Solution Methods provides intriguing comparisons between DA and PR. This book will be interesting and informative to both new and experienced high school- and introductory college-level science teachers.

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Molecular Physical Chemistry for Engineers

by John T. Yates, Jr. and J. Karl Johnson

University Science Books: Sausalito, CA, 2007. 482 pp.
ISBN 978-1891389276. $88.50

reviewed by Luanne Tilstra

As a physical chemist, I encourage chemical engineering majors to visualize the chemical systems they model—to see the connection between the mathematics equations they solve and the physical system those equations represent. I am thrilled to introduce a textbook that aids in this task: *Molecular Physical*

Chemistry for Engineers, coauthored by a chemist (John T. Yates, Jr.) and an engineer (J. Karl Johnson), both associated with the University of Pittsburgh.

Published in 2007 by University Science Books, *Molecular Physical Chemistry for Engineers* is a textbook for a one-term, upper-level undergraduate course. Students using this book should have had a full year of general chemistry with a solid introduction to thermodynamics, equilibrium chemistry, and kinetics. In addition, students should have taken additional coursework in chemical thermodynamics.

The book has eight chapters. Chapter 1, a review of thermodynamics, assumes the student has already had at least one term of thermodynamics. Three wonderfully crafted chapters on quantum mechanics follow. In Chapter 2, the authors present a historical development that establishes a relationship between the complex equations of quantum mechanics and an image of wave−particle duality. Sample calculations in boxes demonstrate the algebra involved in manipulating these equations; discussions on the relevance of the numerical results follow. Chapter 3 uses a presentation of the Schrodinger equation to help students understand the mechanics and meaning of wave functions, integration, and probability densities. Chapter 4 recounts the traditional topics of particle in a box, harmonic oscillator, and rigid rotor. The subject then moves to spectroscopy as a demonstration of the relevance of the previously presented topics. Each chapter concludes with many exercises and problems that range from straightforward practice with fundamental equations to more complex problems that require students to bring together multiple concepts in order to solve realistic problems.

The topic of Chapter 5 is statistical mechanics. Although long (110 pages, including problems), the chapter sets out with an ambitious goal and accomplishes it impressively. Yates and Johnson take the student from a review of and introduction to basic statistics applied to the occupation of quantized energy levels through to specific partition functions and then on to a discussion of ensembles and equilibrium. Unfortunately, the connection between the number of energy states available to a system and the entropy of a system is never clearly presented. I was also disappointed that neither Stirling's approximation nor the LaGrange method was presented; however, the thorough development of the rotational partition function for nonlinear molecules effectively reinforces several quantum mechanical concepts presented in the previous chapters.

Chapter 6, which covers the kinetic theory of gases, builds to a derivation of the equations for calculating the rate of gas-phase collisions. This allows the authors to open Chapter 7 (which concerns chemical kinetics) with collision theory, thereby getting students to think about how molecules approach each other. The progression to a discussion of reaction mechanisms is then both natural and intellectually fulfilling. Chapter 7 closes with a visual presentation of adsorption isotherms as they apply to heterogeneous catalysis.

Chapter 8 presents an overview of molecular modeling methods and strategies. The emphasis of this chapter is on how the use of molecular modeling fits into the framework of chemical engineering problem solving. The chapter uses broad brushstrokes that focus on the overall approaches of particular methods rather than the specific equations and theories involved.

The great strengths of this textbook are the figures and diagrams, the example calculations, the number and variety of problems at the end of each chapter, and the practical applications sprinkled throughout. Although I would not use every single application in my own class, I am most appreciative of the exposure to these applications as well as the opportunity to present them.

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