

## Defining the Scholarship of Teaching and Learning in Microbiology

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### Authors

*Spencer Benson*

University of Maryland-College Park

College Park, Maryland 20742

USA

Email: [sb77@umail.umb.edu](mailto:sb77@umail.umb.edu)

### Abstract

In this article I describe several types of scholarship, give a brief historical overview of teaching scholarship, address the differences between teaching excellence and the scholarship of teaching, and list a set of properties one might use to define the scholarship of teaching microbiology. Lastly I describe some of the relationships between teaching and learning. Ultimately, there is no single definition for the scholarship of teaching and learning; rather, there are many overlapping definitions that are individual, discipline, institution, and situation dependent.

### Article

#### What is the scholarship of teaching and learning?

In this article I describe several types of scholarship, give a brief historical overview of teaching scholarship, address the differences between teaching excellence and the scholarship of teaching, and list a set of properties one might use to define the scholarship of teaching microbiology. Lastly I describe some of the relationships between teaching and learning. Ultimately, there is no single definition for the scholarship of teaching and learning; rather, there are many overlapping definitions that are individual, discipline, institution, and situation dependent.

#### A Brief Background

The concept that teaching involves and requires scholarship is both ancient and new. Many of our greatest philosophers and scientists were first and foremost teachers (e.g., Socrates, Aristotle, Galileo) and it was through their teaching that knowledge was constructed. Aristotle once proclaimed, "Teaching is the highest form of understanding". More recently (1896), the University of Chicago's first president, William Rainey Harper, stated, "The young doctor sometimes forgets that the institution in which he works is under obligation to furnish the best possible instruction to the students whom it has gathered within its walls. If a man is unable to teach, he cannot rightly receive an appointment in the University" (7). Certainly in the first half of the 1900s, teaching was the primary purpose for public and private educational institutions. However, with the emergence and increased availability of public and private research funds, the nature and roles of the University and its reward systems changed (6) from one that focused on teaching to one that focused on research and the scholarship of discovery. In 1990, Ernest Boyer's seminal report *Scholarship Reconsidered: Priorities of the Professorate* (known as the Boyer Report) called upon universities to rethink what scholarship means (3). In the report, Boyer outlined four types of academic scholarship (Box 1). As defined by Boyer, the scholarship of teaching connects and encompasses all the other forms of scholarship and facilitates their perpetuation. Furthermore, it has been argued (9) that the scholarship of teaching is the most central and important type of scholarship.

#### Box 1. Four types of scholarship (3)

*The Scholarship of Discovery:* the discipline research we do and publish.

*The Scholarship of Integration:* the intellectual work and writings that allow oneself and others to construct, see, and understand the connectedness of all things.

*The Scholarship of Application:* the application of knowledge to real world problems, for the betterment of worlds big and small.

*The Scholarship of Teaching:* the works of helping others understand and construct knowledge so they may engage in the other forms of scholarship.

The effects of the Boyer Report are well known. Today on nearly every campus there are faculty members who individually and in groups are actively defining, promoting, and doing the scholarship of teaching. Discussions about teaching and the scholarship of teaching are occurring at many levels-within departments, teaching centers, campus senates, and professional societies. Often these discussions wrestle with the issue of how to define the scholarship of teaching. So what is the scholarship of teaching and learning at the local and personal level? Let us begin by clarifying what it is not.

#### What It Is Not

One thing the 1990 Boyer report failed to do was to clearly define the relationship between the scholarship of teaching and excellence in teaching. During the 1990s there was much discussion of whether excellence in teaching constitutes *prima facie* scholarship of teaching. Certainly, many excellent teachers practice scholarship of teaching. But excellence in teaching is not

necessarily scholarship of teaching. *I use the term excellence in teaching to refer to individuals who through their pedagogy or personal attributes bring about increased student learning.* We all have colleagues and know of teachers who, by their distinct forms of pedagogy, deep commitment and caring, or unique personalities, are able to connect with students in special ways that stimulate and encourage them to learn. Such individuals are recognized as great teachers and are exemplars of excellence in teaching. But their teaching is not necessarily an example of the scholarship of teaching.

Does scholarship of teaching require excellence in teaching? Certainly not! Even though faculty members who engage in the scholarship of teaching strive for excellence and increased student learning, it is possible that when one practices the scholarship of teaching it may not result in increased learning, at least not initially. In my own attempts at the scholarship of teaching, not all of the ideas and things I have tried resulted in increased student learning. Many have had an effect, others have had no effect, and some even resulted in less student learning. This is analogous to my efforts in research (the scholarship of discovery), which focuses on achieving a better understanding of the antimicrobial agents present in Chinese herbal medicines. So, if the scholarship of teaching is not necessarily excellence in teaching and does not necessarily result in increased learning, what is it?

### Recognizing the Scholarship of Teaching

In order for faculty, departments, campuses, and professional societies to recognize the scholarship of teaching, there needs to be a set of defining attributes. Lee Shulman, Pat Hutchings, and others have written extensively on the attributes of teaching scholarship (4, 5, 8-10). In addition, professional societies such as the Society for College Science Teachers (SCST) (11) and the American Association of Colleges of Nursing (AACN) (1) have published guidelines defining scholarship of teaching. Both the SCST and AACN guidelines are discipline specific. The role that a discipline plays in determining what constitutes the scholarship of teaching for that discipline is addressed in the writings of Mary Huber (8). To my knowledge no comparable guidelines have been developed for biology or microbiology educators. What might a set of working guidelines look like for scholarship of teaching in microbiology?

In Box 2 I have listed a set of 12 properties I think define the scholarship of teaching microbiology. This list is adapted from many sources and is best viewed as a working list for future discussions. The list is neither inclusive nor prescriptive since there may be examples of the scholarship of teaching microbiology that have properties or attributes not listed in Box 2. In the next section, I discuss these properties in more detail.

#### Box 2. Twelve properties of scholarship of teaching and learning in microbiology education

1. It involves reflective analysis by the microbiology educator
2. It involves documentation and dissemination of a product that facilitates the learning of key concepts in microbiology
3. It involves appropriate review and critique by other microbiology educators
4. It builds upon the work of other educators in the field of microbiology and other disciplines
5. It allows other microbiology educators to build and improve on it
6. It stimulates intellectual exchanges among microbiology educators
7. It is public; it is work that is shared with peers at all stages of its development
8. It is problem centric; it seeks to understand, solve, or advance knowledge about a problem in or related to microbiology education
9. It is work that is embedded in the principles and foundations of microbiology and microbiology education
10. It involves practical engagement in teaching microbiology
11. It fosters connections within microbiology and to other disciplines
12. It maintains fidelity to: the field of microbiology, the communities microbiology educators share, the educator's identity and sense of self, and most importantly, learning by students

### A Closer Look at the 12 Properties

I suggest that the first five properties are the essential aspects of scholarship of teaching in all disciplines. The first step in the scholarship of teaching begins when reflective analysis takes a central role in the teaching process. Too often teaching occurs without reflection (or going "meta," to borrow a phrase from Pat Hutchings) (9). This is especially true at universities where the scholarship of discovery is the primary (and sometimes sole) measure for faculty performance. How often have we seen colleagues at the end of a semester assign final grades and close the book on the course until he or she teaches it again? Would we do this following 12 weeks of bench work on a research project—close the lab book and sigh with relief? Even worse is the faculty member who opens a file and removes the yellowed notes (or computer disk) from past semesters the day or week before the class starts. Although it is troublesome, we all know that at some institutions it is possible for a faculty member to be considered an adequate teacher by just teaching a class and covering the course content without ever thinking about the process of teaching.

When educationalists talk about metacognition ("going meta"), they mean that we need to periodically step back and deeply and critically reflect upon our teaching before, during, and after the course. Deep critical reflection is a fundamental activity for all types of scholarship. In the scholarship of discovery critical reflection is a necessity that is forced upon the researcher. Could one write a successful grant, paper, or review or design an experiment without deep reflection? Certainly not! Many faculty overlook or never see the need for self-reflection about teaching because of the absence of graduate training in how to teach, the private nature of teaching, and/or the perception that teaching is a low priority activity. To be a successful teacher requires one to reflect on one's teaching; only after deep reflection do the importance, challenges, and benefits of engaging in the scholarship of teaching become clear.

Beyond the obvious benefits of reflecting on our teaching, deep reflection often elevates teaching from a journeyman activity to a creative intellectual activity. When teaching is viewed in this way, it can be directly compared to the scholarship of discovery—the scholarship most of us know best. Thus, when practicing the scholarship of teaching, we develop teaching strategies (experiments); we review, evaluate, and share our experiences with others (publish); peers evaluate our strategies

(peer review) and then develop their own (construction of more knowledge).

The act of sharing (properties 2, 3, 6, and 7) helps to differentiate the scholarship of teaching from excellence in teaching or scholarly teaching. One can be an excellent teacher and even a scholarly teacher without sharing or making public those things that confer excellence. Indeed, teaching frequently occurs without peer review. Peer review and sharing can take many forms, such as inviting others to visit our classes, discussing class and teaching problems with peers, developing common exam questions, disseminating teaching tools by writing journal articles or giving presentations, and organizing discussions about teaching and learning. In each instance, a community of peer teachers is enjoined for support, review, and critique.

Community building and sharing are the centerpieces of the scholarship of discovery (research), and it should be remembered that scholarship of discovery was recognized and rewarded only when it became reviewed, critiqued, and public. For microbiology educators there are now many venues for public sharing and dissemination of peer-reviewed products of scholarship in teaching. These include the annual ASM Undergraduate Education conferences, the new Microbiology Education journal, Microbe Library curriculum resources, and various ASM listservs. In addition, a number of other professional science societies and groups have appropriate venues for publication of articles on microbiology education, and there are several on-line journals devoted to the scholarship of teaching and learning (see the resources section at the end of this article). Each of these venues stimulates exchanges among microbiology educators.

For me, properties 4, 5 and 8 best characterize the scholarship of teaching. All of us routinely borrow or steal from our colleagues teaching tricks and ideas, which we modify to fit our teaching needs and environment. In doing this, we are building upon the work of others. Indeed one of the main reasons for attending the ASM educational conferences is to collect new ideas that we can adapt to our teaching. Many of us experience personal satisfaction in developing educational ideas or adapting existing ones to our needs. One of the rewards for developing or adapting a new teaching idea is when a colleague values it enough to adapt it for use in his or her class.

The problem-centric vision of the scholarship of teaching is well presented and described in the writings of Randy Bass, a faculty member in American Studies at Georgetown University (2). His description of the scholarship of teaching clearly reinforces its similarity to the scholarship of discovery. For example, a research project might ask, "How do bacteria know to move toward food and away from detrimental environments?" In the scholarship of teaching, the question might be, "How does adding a virtual lab on determining colony forming units affect students' understanding of the concept of dilutions?" Both situations use a similar problem-oriented framework, and in each case the scholar defines a problem and then designs approaches or experiments to solve or better understand the problem. It is worth noting that Bass's view of the scholarship of teaching stems from a professional lens (American Studies) far removed from microbiology; yet he uses a framework all scientists recognize and employ in the scholarship of discovery.

Properties 9 through 12 are important but may not be essential to the scholarship of teaching. However, they do help to frame the scholarship of teaching in a broader context. All disciplines contain attributes (facts, principles, ideas, and connections) that define the discipline and make it recognizable by students and practitioners. For students to understand microbiology and to be able to think like a microbiologist, they must have an understanding of and a feeling for these attributes. Thus, the scholarship of microbiology teaching needs to encompass and be connected to the fundamental characteristics that define microbiology. For example, scholarship that seeks to understand how class length affects learning is an appropriate problem within the scholarship of teaching, but it would not be specifically connected to the discipline of microbiology. In contrast, scholarship that seeks to understand how length of a lab period affects learning is directly linked to the discipline of microbiology education because the laboratory experience is one of the fundamental attributes of microbiology and microbiology education.

The scholarship of teaching microbiology needs to focus on the act of teaching microbiology. While articles and position papers on science education or the need for more or different microbiology education are types of scholarly works, they may not represent scholarship of teaching microbiology. However, articles describing solutions to specific problems or issues in microbiology education and articles describing teaching tools that result in improved teaching or learning of microbiology are clear examples of scholarship in microbiology education.

Helping students make connections between facts, knowledge, and the world outside of the classroom is a goal of good teaching. Often in the scholarship of teaching one seeks by design, purpose, or consequence to highlight and accentuate such connections. Among all of the biological sciences, microbiology is the one that is most deeply connected to the world we live in; everything on the planet and in our own lives is directly or indirectly affected by microbes. Thus, it is often possible to develop connections that extend beyond microbiology to real world issues, problems, and solutions. In some instances, building these connections can also provide insights into and better understanding of how we teach microbiology and how students learn microbiology.

The final property is taken from the writing of Lee Shulman (10) and speaks to the moral integrity and fidelity of teaching. Some of the fidelities are obvious. When we teach microbiology, it should be the focus of our class—not molecular biology, cell biology, immunology, or some other subject. The material taught should be consistent with current knowledge in the field of microbiology and should be aligned with the ASM educational core themes and concepts. Property 12 also underscores the importance of finding our own teaching voice and developing it. Like painters, musicians, actors, and other artists, good teachers need to develop a style based on their strengths. In many cases exceptional teachers are artistic, and the linkage between artistic ability and excellence in teaching may not be coincidental.

Finding one's teaching voice and developing it takes time, effort, practice, and reflection. I am envious of my colleagues who are able to use humor or drama as a mechanism to teach. However, whenever I attempt using either, I fail; generally the class doesn't get it, and I am left with a classroom filled with blank stares and silence. The harder I try the more disastrous the results. With reflection I have come to realize that the reason I fail is that humor is not part of my natural teaching presence. Thus, it is not surprising that when I disregard fidelity to my identity and try to be something I am not, my teaching does not work. (But, I am still envious of my colleagues who can pull this off.)

Lastly and most importantly scholarship of teaching microbiology needs to embrace the fidelity of student learning and critically assess deep as well as shallow learning. It should not rely solely on convenient or easy metrics for measuring how well the student has learned the fundamentals of microbiology.

### Teaching and Learning

During the last decade, the scholarship of teaching has evolved into the scholarship of teaching and learning. This linkage in part resulted from a better understanding of how learning occurs, increased use of activities that enhance learning, increased focus on learning outcomes as opposed to learning processes, an atmosphere of greater accountability, and the activities of campus teaching centers that have helped to focus faculty efforts on student learning rather than content delivery. While we strive as educators and scholars to connect teaching and learning, they are not inherently coupled. Learning can occur in the absence of teaching and too often teaching occurs without true learning. Figure 1 illustrates four types of connections between teaching and learning. In A the two are disconnected; what is being taught may not be what the student is learning. Unfortunately this too often represents what occurs in university classrooms. In this scenario, what the student often learns is how to get a good grade on the next test, and the teacher often functions as a journeyman-untrained, or at best self-trained-whose goal is to get through the class or to cover the course material. It is unlikely the teacher functions as a scholar or artist who strives to improve the course and in doing so perfects his or her teaching craft. In B the two processes are separate but connected by the teacher's acts. What is taught is helping to direct what is being learned, although the process is unidirectional. This represents what occurs most often in the university setting, especially when the class size is large. In C, the two processes remain separate but connected and the flow of information and ideas is no longer unidirectional although it may be biased in the teacher-to-student direction. This type of relationship occurs more easily when the class is small or when teachers work one-on-one with individual students. It represents a type of educational experience that is often powerful and transforming. In D, teaching and learning are seamlessly connected. This may be the "holy grail" of teaching that we seek but rarely occurs. In it both the teacher and student share the roles of teacher and learner and learning is bidirectional.

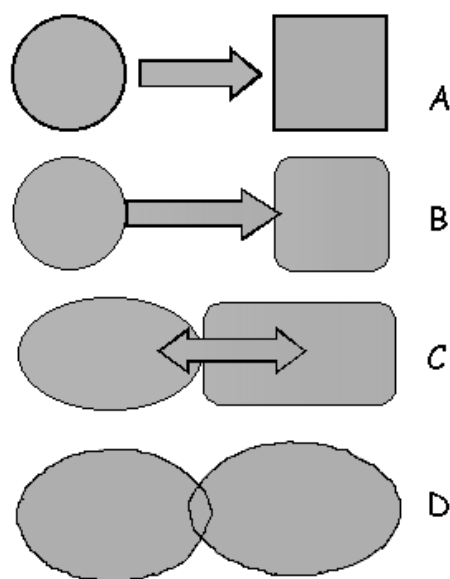


Fig. 1. Teaching and learning relationships

In actuality good courses taught by dedicated teachers have all of the situations depicted in Fig 1. The amount of each type is determined by external factors such as class size, room lay out, and time of day, as well as by internal factors such as the nature of the students, the teacher's comfort with the course material, other demands on the teacher's time, and the teacher's personal visions of teaching and the scholarship of teaching and learning.

### Summary

In this article I have given a very brief historical overview of the scholarship of teaching, placed it in a context with other forms of scholarship, and provided a set of properties one might use in defining the scholarship of teaching microbiology. Defining the scholarship of teaching microbiology is not a simple task because the scholarship of teaching is best defined by a set of attributes that can be general (reflective, public, connected), discipline (lecture, laboratory, practical skills) and situation specific (institution type, class size, student type, teaching platform [e.g., traditional versus distance education]). Perhaps this is why it has been difficult for departments and colleges to embrace, recognize, evaluate, and reward the scholarship of teaching and learning. My hope is that this difficulty will eventually be seen as a challenge to conquer rather than a barrier that separates and supports the old adage "Those who can do; those who can't teach." For me the challenges of good teaching and the scholarship of teaching are more difficult and intellectually challenging than those of the scholarship of discovery (research). However, in reflecting on the commonalities and the means for dealing with the challenges shared by both types of scholarships, I have become a better teacher and a better researcher.

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#### Resources for Scholarship in Microbiology Education

ASM's sites for publishing scholarship in microbiology teaching:

- MicrobeLibrary Curriculum resources - <http://www.microbelibrary.org/>
- Microbiology Education Journal
- Focus on Microbiology Education Newsmagazine
- ASM's Board of Education and Training - <http://www.asm.org/Education/index.asp?bid=369>
- ASM Core Themes and Concepts for an Introductory Microbiology Course - <http://www.asm.org/Education/index.asp?bid=10051>

Carnegie Foundation for the Advancement of Teaching

- <http://www.carnegiefoundation.org/>
- An Annotated Bibliography of the Scholarship of Teaching and Learning in Higher Education - <http://www.carnegiefoundation.org/CASTL/highered/bibliography.htm>

American Association for Higher Education

- Webcenter - <http://aahe.ital.utexas.edu/>
- AAHE Bulletin - <http://www.aahe.org/bulletin.htm>

Online Journals on the Scholarship of Teaching and Learning

- The Journal of Scholarship of Teaching and Learning (JoSoTL)  
[http://www.iusb.edu/~josotl/resources\\_on\\_sotl.htm](http://www.iusb.edu/~josotl/resources_on_sotl.htm)
- *Inventio* - <http://www.doiit.gmu.edu/inventio/>

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