The PULSE Vision & Change *Snapshot* Rubric version 2.0

The PULSE Vision & Change Snapshot Rubric is designed as a tool for faculty and administrators to gain a quick overview of the alignment of their life science program with some of the major elements of the recommendations of the *Vision and Change* (V&C) report (2011). The PULSE Vision & Change Snapshot Rubric includes components of the five separate rubrics that make up the complete PULSE Vision & Change rubrics: 1) Curriculum Alignment, 2) Assessment, 3) Faculty Practice/Faculty Support, 4) Infrastructure, and 5) Climate for Change. The complete set of rubrics is designed as a diagnostic tool to be used in a self-study to evaluate the extent of implementation of the recommendations of the Vision and Change (V&C) report (2011) in life science programs and majors. They were developed based on the features expected in a department that had fully implemented all of the V&C recommendations. The rubrics help departments and programs highlight the areas where they stand out and areas where they have made less progress. The complete set of rubrics is part of a Recognition process that acknowledges departments and programs that have made progress in implementation of V&C recommendations. More information is available here: http://www.pulsecommunity.org/page/recognition.

This short Snapshot Rubric is intended to be used for several purposes: a) as an entry point or gateway to the complete set of five rubrics, b) as a brief overview for conference and workshop participants, and c) as a standardized instrument to collect data across the PULSE regional meetings in various geographical locations. Most of the criteria come directly from the complete set of rubrics, but in a few instances multiple full rubric criteria have been collapsed into one for the sake of brevity.

Departments can compare their scores to those of other institutions (of similar or different types) and use the data to develop plans for program changes to better align with national priorities for STEM education. Data collected using the rubrics are extremely valuable in understanding the landscape of teaching and learning that exists and how that landscape is changing over time. Thus, we are very interested in collecting data from departments who fill out the Snapshot rubric. We have established an online rubric data entry portal. Please consider depositing your department's information in the Snapshot rubric data entry portal (http://www.pulsecommunity.org/page/recognition)

The use of the term 'faculty' throughout the rubric is meant as a generic term for the range of possible titles for all those who are instructors in any course that is part of the program being evaluated. The use of 'term' is intended to encompass whatever unit is relevant for individual institutions, such as semester or quarter.

The specific instructions in the next section go through each criterion of the Snapshot rubric, providing details to clarify meaning and scoring. They are best used concurrently with the rubric. Links are provided for navigation between the instructions and rubric sections. These links *(go to rubric, go to instructions)* can be found next to each section heading and will take the PDF-user back and forth within this document.

Instructions for the PULSE Vision & Change *Snapshot* Rubric v2.0

The core concepts and competencies described in *Vision and Change* reflect the combined thinking of thousands of scientists over the past decade or more. For specific descriptions of the core concepts and core competencies, please refer to Chapter 2 of the 2011 *Vision and Change* report, particularly pages 12-16. Because of this strong consensus among life scientists, we are using the language in the *Vision and Change* 2011 report as the basis for this evaluation.

A. INTEGRATION OF CORE CONCEPTS INTO CURRICULUM *(go to rubric)*

A1 – Integration of core concepts into the curriculum
The five V&C core concepts are evolution; structure and function; information flow, exchange and storage; pathways and transformations of energy and matter; and systems. For details of specific concepts to be covered, refer to the BioCore Guide (Brownell *et al.* 2014) available here http://www.lifescied.org/content/suppl/2014/05/16/13.2.200.DC1/Supplemental_Material_2.pdf.

B. INTEGRATION OF CORE COMPETENCIES INTO CURRICULUM *(go to rubric)*

B2 – Integration of core competencies into the curriculum
This criterion measures the number of competencies that students are exposed to in detail in the process of completing a major/program.

B3 – Extent of core competency integration into the curriculum
This criterion measures whether students have multiple detailed exposures to the competencies in the process of completing a major/program.

The following are brief descriptions of the six core competencies described in the *Vision and Change* report (2011). More detail can be found in Chapter 2 of the report.

Process of science
This competency concerns development of student competency regarding the application of the process of science. Achieving this competency requires providing students with opportunities to practice formulating hypotheses, testing them experimentally or observationally, and analyzing the results.

Quantitative reasoning
This competency concerns development of student competency regarding the use quantitative reasoning. For quantitative reasoning resources visit this URL: http://www.nimbios.org/resources/. For a recent paper on integrating quantitative reasoning into an introductory biology course see: Hester *et al.* CBE—Life Sciences Education Vol. 13, 54–64, Spring 2014.

Modeling and simulation
This competency concerns development of student competency regarding use of modeling and simulation. Because biological systems are complex, changing, and interacting, the opportunity to learn about and practice modeling and simulating those systems can provide students with insight into the important means of clarifying these dynamic interactions. Examples of modeling/simulation software include SimBio (http://simbio.com), STELLA (http://www.iseesystems.com), and NetLogo (http://ccl.northwestern.edu/netlogo/).

Interdisciplinary nature of science

This competency concerns development of student competency to tap into the interdisciplinary nature of science. Sub-disciplines of biology are often reaching to other disciplines to learn techniques and approaches that can shed light on biological phenomena. Achieving this outcome can be supported by a climate that values interdisciplinary thinking and provides opportunities for students to develop some fluency in other disciplines through associated coursework, course activities (e.g. by integrating interdisciplinary case studies), course-based interaction with students and experts in other disciplines or in collaborations outside the classroom setting. Another way to foster interdisciplinary competence is through courses that are co-taught by a life scientist and an instructor from another discipline, e.g. mathematics, computer science, chemistry, anthropology, physics, and engineering.

Communication and collaboration

This competency concerns development of communication skills. It is important for students to learn to communicate effectively in typical written and oral scientific formats, and this communication is necessary for effective collaboration with colleagues within and outside the student's discipline.

Understanding of the relationship between science and society

This competency concerns development of student competency to understand the relationship between science and society. Scientific study and research are conducted within social structures and, consequently, scientists need to understand how those social structures work and how to participate in society such that both science and society benefit. Another aspect is instilling in students the idea that science can be used to help solve major societal problems, for example human disease and environmental degradation. For this connection to be made, students need to understand not only the science, but also the complexity of the social problems that are addressed.

C. COURSE LEVEL ASSESSMENT *(go to rubric)*

The PULSE website (http://www.pulsecommunity.org/page/assessment) contains links to many assessment tools listed below.

C4 – Linkage of summative assessments to learning outcomes

This criterion requires careful articulation of course-level learning outcomes and intentional selection or development of assessments to measure student achievement of the outcomes. The PULSE community website link provided at the beginning of this section includes a wide variety of assessments that can be used in specific life science courses or could provide ideas for development of local course-specific instruments. A major goal of any assessment program should be to gain information that can be used to improve student learning in the future; a second important goal would be demonstration of achievement for specific students. For a score of three or four, it is essential that assessments be valid and carefully mapped to the outcomes (rather than generically appropriate for the course such as a standardized test used across many sections which provides broad information about student knowledge, but is difficult to use for specific course improvements).

C5 – Evaluation of time devoted to student-centered activities in courses

This criterion is focused on time spent in student-centered activities. Ideally, both student and peer-observers should have a chance to evaluate this factor. For student assessment, course evaluations might include questions about specific active learning techniques. A variety of instruments for peer observation to assess this criterion are currently in use, for example, The Classroom Observation Protocol for Undergraduate STEM (COPUS) (http://www.lifescied.org/content/12/4/618.full) and the Reformed Teaching Observation Protocol

(RTOP) (http://serc.carleton.edu/NAGTWorkshops/certop/reformed_teaching.html). 'Term' refers to either semester or quarter, as appropriate for the specific institution.

D. PROGRAM LEVEL ASSESSMENT *(go to rubric)*

D6 – Assessment of the six V&C competencies at the program level

This criterion seeks to specifically address the integration of the *Vision and Change* core competencies into a major or program. Ideally, this would best be evaluated with some sort of single "exit exam" based on *Vision and Change* core competencies. However, such an instrument does not currently exist. Some standardized tests, for example the Educational Testing Service's Major Field Test in Biology, assess a subset of *Vision and Change* core competencies. A second option is to use some sort of portfolio evaluation during the students' final year in the program. The use of ePortfolios for this purpose is gaining traction. See http://net.educause.edu/ir/library/pdf/eli3001.pdf for an overview or browse the *International Journal of ePortfolio* (http://www.theijep.com).

D7 – Use of data on program effectiveness

This criterion speaks to what extent the analyzed program effectiveness data is used to strengthen the program and encourages departments to consider collecting and analyzing program effectiveness data to inform program revision. Direct measures of student learning include comprehensive exam/concept inventory scores for graduating students, portfolios, capstone projects, or oral examinations. Indirect measures include course grades, measures of the number of students that progress to graduate school or employment, and comparison of enrollment numbers. A fairly comprehensive list of direct and indirect measures of student learning can be found at: http://www.csuohio.edu/offices/assessment/exmeasures.html.

E. PEDAGOGY AND STUDENT HIGHER LEVEL LEARNING *(go to rubric)*

E8 – Opportunities for inquiry, ambiguity, analysis, and interpretation in coursework

This criterion is focused on the degree to which scientific inquiry is incorporated into courses, whether or not the course includes a formal laboratory component. In other words, to what degree do students have the opportunity to do what scientists do, namely design experiments, formulate hypotheses, and evaluate data? One key component is to expose students to data sets where the interpretation of the data affects the conclusions drawn, exposing them to the ambiguity inherent in scientific investigation. Another key point here is that class time should not be dedicated solely to presentation of facts, but instead should expose students to the process of science, namely hypothesis generation, hypothesis testing, data analysis, and drawing scientific conclusions.

E9 – Student metacognitive development

This criterion addresses the degree to which instructors encourage students to reflect on their own learning or metacognition. Metacognition is defined as the process of setting challenging goals, identifying strategies to meet them, and monitoring progress toward them. For scores of 3 or 4, instructors integrate the practice of effective learning strategies supported by cognitive research and reflection on learning into course assignments and assessments. An example of a metacognitive assignment is asking students to review returned exams and correct their answers. The use of the term 'faculty' is meant as a generic term for the range of possible titles for instructors in any course that is part of the program being evaluated.

E10 – Student higher-order cognitive processes

This criterion is focused on the type of thinking required of students and whether assignments and assessments are designed to give students adequate practice, particularly in developing higher order cognitive skills. The lowest order cognitive processes focus on *knowledge and comprehension* and require students to memorize, name, label, define, arrange, classify, identify, restate, and select. The process of application requires students to apply, demonstrate, interpret, use, or solve. Higher order cognitive processes include *analysis* (requiring students to analyze, categorize, compare, contrast, differentiate, and test), *synthesis* (requiring students to compose, create, design, organize, and propose), and *evaluation* (requiring students to appraise, assess, defend, evaluate, judge, and predict).

E11 – Alignment of pedagogical approaches with evidence-based practices
This criterion is focused on the use of evidence-based practices in student learning. Two factors are being assessed here: first, the degree to which student-focused approaches are used in the classroom and second, the number of faculty members who are using these approaches. There is a wide range of student-focused approaches including use of student response devices (clickers) and group activities often associated with case-based or problem-based learning. To support claims of extensive use of evidence-based pedagogy, scoring of active learning using COPUS (http://www.lifescied.org/content/12/4/618.full) or other tools would be required to justify a score of 4. Counts of courses using evidence-based, active engagement strategies and inquiry vs. traditional lecture format would be appropriate evidence for scores of 2-3.

E12 – Awareness of national efforts in undergraduate STEM education reform
This criterion addresses the degree to which faculty members are aware of national reports on biology and STEM education like the 2011 AAAS *Vision and Change* report, the 2015 *Vision and Change: Chronicling the Change* report or the 2012 *Engage to Excel* PCAST (Presidential Council of Advisors on Science and Technology) report. Are faculty members aware of the HHMI Summer Institutes? Are faculty members interested and aware that these reports support making their classrooms student-focused and inquiry-based? Are faculty aware and willing to consider that there is strong evidence from educational and cognitive science studies that student-centered teaching strategies are more effective for learning than lecture-based teaching?

F. LEARNING ACTIVITIES BEYOND THE CLASSROOM *(go to rubric)*

F13 – Intramural and/or extramural mentored research: student participation
This criterion pertains to the number of students that carry out mentored student research. Research here is intended to refer to research that takes place outside of formally scheduled laboratory classes or capstone courses. Examples include research with a faculty member from the institution, research with a faculty member from another institution, summer mentored research opportunities, or research opportunities with local biotech/pharmaceutical/environmental companies. To be considered, the student must participate in research for a minimum of one term or one summer. The student time commitment minimum is 10 hours per week for academic year work.

F14 – Supplemental student engagement opportunities
This criterion addresses whether the institution offers supplemental student engagement opportunities. These opportunities include 1) availability of tutoring (Are tutors available? Are there sufficient tutors to satisfy student demand? Are the tutors free for students or at least free for students on financial aid?), 2) Peer mentoring (Are there formal peer mentoring programs set up by the institution? These could be one-on-one programs or programs where a peer mentor works with multiple students.), 3) Supplemental instruction (This would include formal peer-led study groups that are associated with the class or extra class sections for students that need help mastering fundamentals.), 4) Academic advisors (Are academic advisors available for students? Are there sufficient academic advisors to meet student demand? Do students meet with academic advisors frequently enough to establish an effective and beneficial relationship?), 5) Learning communities (Are there opportunities for life science students to live/socialize together?), 6) Interest-based or career oriented clubs

(clubs organized around pre-health, pre-vet, biotech, pharma, life science majors. The effectiveness of these clubs can be assessed by the number of students that are actively involved or by the number of events they sponsor per year), and 7) Practicums and internships (this partially overlaps with F13 above, but here the practicums or internships are not strictly research-based, e.g. they could be more job or profession specific such as shadowing opportunities, co-ops, service learning, etc.). 'Institutionalized,' for a score of 4, refers to permanent funding for these opportunities.

G. INFRASTRUCTURE AND CLIMATE *(go to rubric)*

G15 – Flexibility of teaching spaces
This criterion is related to the quality of the actual teaching space. When estimating the percentage of classrooms, for the denominator, use the classrooms that are generally assigned to the department for teaching; for the numerator, use the subset that is flexible and reconfigurable. A flexible and reconfigurable classroom contains furniture that can be easily (and quickly) rearranged to accommodate student groups of different sizes. Single level classrooms are generally more conducive to active learning than tiered rooms. An example of a classroom that is not flexible and reconfigurable would be a lecture hall with multiple tiers and fixed seating.

G16 – Mechanisms for collaborative communication on significant educational challenges
This criterion addresses the degree to which stakeholders (faculty, staff, administrators, etc.) across the institution effectively communicate about nationally-recognized and institution-specific challenges and issues in undergraduate STEM education. Such discussions might include how to address recommendations from national reports and studies, educational best practices, data on student outcomes, and measures of student success. Institution-specific data and issues might include DFW rates, retention, persistence, success of students from non-traditional and underrepresented backgrounds, and outcomes such as graduation rates, types of employment, rate of entry into additional educational programs, etc. For scores of 3 and 4, formal mechanisms such as committees or working groups are likely to exist that actively engage key stakeholders across the institution around these issues. To achieve a score of 4, discussions that identify significant disparities or issues must lead to changes in programs to address those issues.

G17 – Teaching in formal evaluation of faculty
Formal evaluation includes regular/annual review, promotion, and tenure of faculty. Use of 'faculty' is meant as a generic term for the range of possible titles for instructors in any course that is part of the program being evaluated. Although all institutions value teaching, different institutions weigh components of faculty effort (e.g. teaching, research, service) differently. Student course evaluations are variable at different institutions. At a minimum, course evaluations ask for student perceptions about the quality of the class and the quality of the faculty. At the high end, course evaluations might ask about the teaching approaches utilized and student perception of learning gains. Peer evaluations are reviews by other faculty of teaching effectiveness and can include information about the strategies utilized and the level of student engagement. Scholarly teaching (scientific teaching) is the practice of evaluating whether students achieve learning goals and reflecting on teaching practices to continuously improve student outcomes.

PULSE Snapshot Rubric v2.0

Institution Type: _______________ Institution Name: _______________________Program/Department/Major: ____________________Your Name (Optional) _________________________

	Criteria	0 (Baseline)	1 (Beginning)	2 (Developing)	3 (Accomplished)	4 (Exemplar)
A. INTEGRATION OF CORE CONCEPTS INTO CURRICULUM *(go to instructions)*						
1	**Integration of core concepts into the curriculum**	None of the core concepts are covered multiple times in the curriculum	One or two of the core concepts are covered multiple times in the curriculum	Three of the five core concepts are covered multiple times in the curriculum	Four of the five concepts are covered multiple times in the curriculum	All five core concepts are covered multiple times in the curriculum
Core concepts are: Evolution; Structure/function; Information flow/exchange/storage; Pathways and transformations of energy and matter; Systems						
B. INTEGRATION OF CORE COMPETENCIES INTO CURRICULUM *(go to instructions)*						
2	**Integration of core competencies into the curriculum**	Students are not exposed to any of the core competencies in significant detail	Students are exposed to one or two of the core competencies in significant detail	Students are exposed to three of the six core competencies in significant detail	Students are exposed to four or five of the six core competencies in significant detail	Students are exposed to all six of the core competencies in significant detail
3	**Extent of core competency integration into the curriculum**	None of the core competencies are covered multiple times in the curriculum	One or two of the core competencies are covered multiple times in the curriculum	Three of the six core competencies are covered multiple times in the curriculum	Four or five of the six core competencies are covered multiple times in the curriculum	All six of the core competencies are covered multiple times in the curriculum
Core competencies are: Process of science; Quantitative reasoning; Modeling and simulation; Interdisciplinary nature of science; Communication and collaboration; Understanding of the relationship between science and society						
C. COURSE LEVEL ASSESSMENT *(go to instructions)*						
4	**Linkage of summative assessments to learning outcomes**	Summative assessments are not linked to learning outcomes	Some courses have summative assessments that measure learning outcome achievement	Many courses have summative assessments that measure learning outcome achievement	The majority of courses have summative assessments that measure learning outcome achievement	The majority of courses have summative assessments that measure learning outcome achievement as part of a coherent, evidence-based assessment plan
5	**Evaluation of time devoted to student-centered activities in courses**	Time spent in student-centered activities is not measured	Time spent in student-centered activities is informally estimated at the end of term	Time spent in student-centered activities is documented by approximation after the fact in formal course evaluation at the end of term	Time spent in student-centered activities is informally tracked throughout the term and reported in formal course evaluations at the end of term	Time spent in student-centered activities is formally documented at points throughout the term and reported in formal course evaluations at the end of term
D. PROGRAM LEVEL ASSESSMENT *(go to instructions)*						
6	**Assessment of the six V&C competencies at the program level**	Competencies not assessed at the program level	Development of at least one of the competencies assessed at the program level	Development of 2-3 competencies assessed at the program level	Development of 4-5 competencies assessed at the program level	Development of all 6 V&C competencies assessed at the program level
7	**Use of data on program effectiveness**	Program is not revised in response to data on program effectiveness	Program revision occurs in response to indirect data on program effectiveness only	Program revision occurs in response to indirect data and one source of direct data on program effectiveness	Program revision occurs in response to indirect data and 2-3 sources of direct data on program effectiveness	Program revision occurs in response to indirect data and 4 or more sources of direct data on program effectiveness

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E. PEDAGOGY AND STUDENT HIGHER LEVEL LEARNING ***(go to instructions)***						
8	**Opportunities for inquiry, ambiguity, analysis, and interpretation in coursework**	Most courses, regardless of lab component, do not provide opportunities for inquiry, ambiguity, analysis, and interpretation; students have little exposure	25% or less of courses, regardless of lab component, provide opportunities for inquiry, ambiguity, analysis, and interpretation; a subset of students are exposed	~26-50% of courses, regardless of lab component, provide opportunities for inquiry, ambiguity, analysis, and interpretation; many student are exposed	Greater than 50% of courses, regardless of lab component, have opportunities for inquiry, ambiguity, analysis, and interpretation; most students are exposed	Opportunities for inquiry, ambiguity, analysis, and interpretation are the norm in all courses, regardless of lab component; nearly all students are exposed; many get multiple opportunities to practice
9	**Student metacognitive development**	Faculty do not guide students to reflect on and understand how to use learning strategies that are supported by cognitive research	Less than 25% of faculty guide students to reflect on and understand how to use learning strategies that are supported by cognitive research	25-50% of faculty guide students to reflect on and understand how to use learning strategies that are supported by cognitive research	51- 75% of faculty guide students to reflect on and understand how to use learning strategies that are supported by cognitive research	Greater than 75% of faculty routinely and intentionally guide students to reflect on and understand how to use learning strategies that are supported by cognitive research
10	**Student higher-order cognitive processes**	Exams and assignments across the curriculum are focused on the lowest-level cognitive processes (memorization/recall)	Exams and assignments across the curriculum are typically at lower cognitive levels, but may include understanding and application in addition to recall	Less than 25% of courses routinely challenge students to use higher-order cognitive processes (e.g., synthesize, evaluate, create) on exams and assignments	25-50% of courses routinely require students to use higher-order cognitive processes, but such practice is not yet ubiquitous across the curriculum	Work at higher cognitive levels is the norm across the curriculum, and instructors are adept at developing assignments and exams for practice at each level
11	**Alignment of pedagogical approaches with evidence-based practices**	Lecturing without student engagement is the dominant practice in all courses	Evidence-based pedagogies are used by one or few instructors	A core group of faculty are shifting department attitudes and practices toward more widespread use of evidence-based pedagogies, although courses in which students experience uninterrupted lecture are common	Nearly all faculty are learning about and experimenting with evidence-based pedagogical practices, although courses in which students experience uninterrupted lecture are a standard part of the curriculum	Majority of faculty routinely use evidence-based practices, so that students rarely sit passively listening to lectures for an entire class session
12	**Awareness of national efforts in undergraduate STEM education reform**	Faculty are isolated from the national dialogue	Pockets of awareness of the need for reform and national efforts exist	Greater than 25% of the faculty are aware of the need for reform and national efforts	Greater than 50% of the faculty are aware of the need for reform and national efforts	Greater than 75% of faculty are aware of the need for reform and national efforts in undergraduate STEM education
F. LEARNING ACTIVITIES BEYOND THE CLASSROOM ***(go to instructions)***						
13	**Intramural and/or extramural mentored research: student participation**	No students participate in mentored research	Less than 15% of students graduate with one or more summer/term of mentored research	15-30% of students graduate with one or more summer/ term of mentored research	31-60% of students graduate with one or more summer/ term of mentored research	Greater than 60% of students graduate with one or more summer/term of mentored research
14	**Supplemental student engagement opportunities**	Supplemental engagement opportunities are absent	One or two supplemental engagement opportunities are offered, but available to few students	More than two supplemental engagement opportunities are available, but only to a small subset (~25%) of students	Supplemental engagement opportunities are diverse, but capacity is limited (~50% of students)	Supplemental engagement opportunities are diverse, widely available to all students, and institutionalized

G. INFRASTRUCTURE AND CLIMATE ***(go to instructions)***

15	**Flexibility of teaching spaces**	All assigned classrooms are lecture style with fixed seating	Less than 10% of assigned classrooms are flexible and reconfigurable to encourage student interaction	10-50% of assigned classrooms are flexible and reconfigurable to encourage student interaction	51-75% of classrooms are flexible and reconfigurable to encourage student interaction; different types of classrooms are available for diverse teaching styles	More than 75% of classrooms are flexible and reconfigurable to encourage student interaction; different types of classrooms are available for diverse teaching styles
16	**Mechanisms for collaborative communication on significant educational challenges**	There is little discussion of educational challenges that impact student success (e.g. retention, persistence, success of underrepresented students)	There is informal discussion of educational challenges that impact student success, but discussions include only a limited group of stakeholders with infrequent, irregular meetings	Informal discussion of educational challenges that impact student success includes the majority of college stakeholders, but discussions are irregular	Formal communication mechanism such as a working group or committee exists for discussion of educational challenges that impact student success. The committee includes the majority of college stakeholders	Formal communication mechanism (working group or committee) exists for discussion of educational challenges that impact student success. The committee includes the majority of college stakeholders, who collaborate actively to make changes that have impact
17	**Teaching in formal evaluation of faculty**	Teaching is not considered in the evaluation of faculty	Teaching is considered a minor component in the evaluation of faculty, but is based solely on student course evaluations that assess only the student perception of the quality of the class and faculty	Teaching is considered an important component of the overall formal evaluation. Evaluation is based on both student course evaluations and peer evaluations	Teaching is considered a major component of the overall formal evaluation. Evaluation is based on student course evaluations, peer evaluations, and recognition of the importance of scholarly teaching	Teaching is considered a major component of the overall formal evaluation. Evaluation is based on student course evaluations, peer evaluations, assessment of learning gains, and recognition of the importance of scholarly teaching