International Union of Physiological Sciences Teaching Workshop, April 7–10, 2005, Pali Mountain, California

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Hansen, Penelope A., and Ann Jervie Sefton. International Union of Physiological Sciences Teaching Workshop, April 7–10, 2005, Pali Mountain, California. Adv Physiol Educ 29: 216–226, 2005; doi:10.1152/advan.00053.2005.—Fifty-six physiologists from fourteen countries participated in the sixth International Union of Physiological Sciences Teaching Workshop. The four-day program included a poster session, a debate on integrative versus disciplinary curricula, and interactive lectures on evidence-based education, inquiry laboratories, and student preparation for physiology courses. Participants worked in small groups on one of four topics: developing free web-based laboratory resources, information technology, curriculum planning and design, and other issues in classroom teaching. Everyone enjoyed a get-acquainted party on the first night and revealed bear tracks on the property the next morning.

The program included four plenary sessions with the following talks: Evidence-based education (Ann Sefton), Inquiry laboratories (Marsha Matyas), Are your students prepared to learn physiology? (Rob Carroll), and Integrative versus disciplinary curricula: a debate (Joel Michael and Arif Siddiqui). There was a poster session and 10 h of small group work, for which participants chose one of four discussion tracks. The group facilitors prepared the summaries of their discussions that follow.

DISCUSSION TRACK I: THE LABORATORY RESOURCE PROJECT

Cofacilitators
Dee Silverthorn and Joel Michael

Participants
Elaine Brubaker, Kim Henige, Daniel Hodyc, Meri Kerejoky, Chris Ladipo, Nikki McDaniel, James Marker, Marsha Matyas, Minama Siagian, Baara Skuladottir, Sanjay Kr. Sood, Thad Wilson, and Amie Yenser

Background
This project will bring together a diverse group of physiology teachers from around the world to adapt two existing but out-of-date sets of laboratory experiments. The final product will be a collection of educationally effective, simple to do, and economical ideas for laboratory exercises. This new sourcebook will be available for free, on-line access from an American Physiological Society (APS) website. This project is being funded by a grant to Dee Silverthorn (Primary Investigator), Joel Michael (Co-Primary Investigator), and Marsha Matyas (Co-Investigator) from the National Science Foundation (NSF).

Work at Pali Mountain
We first reviewed the history of this project. In brief, the Teaching Committee of IUPS produced A Source Book of Practical Experiments in Physiology Requiring Minimal Equipment in the early 1990s. This sourcebook was commercially published, but it is very difficult to locate now and is quite out of date. Ann Sefton, the present Co-Chair of the Teaching Committee, proposed that an updated version be prepared, and Dee Silverthorn and Joel Michael wrote a proposal (Physiology for the 21st Century: a Sourcebook of Effective and Economical Experiments) that was submitted to the NSF and approved. Funds from this grant provided partial support for the IUPS Teaching Workshop in April 2005.

The group then discussed the issue of which of the “old” experiments, if any, should be excluded from the new sourcebook. Experiments using human subjects comprise the bulk of the “old” experiments, although some of them involve procedures such as drawing blood that probably cannot now be done at North American schools. Similarly, there are “old” experiments that use vertebrates (rats and rabbits) that are increasingly expensive (everywhere) and that often generate strong opposition (at least in the United States and Europe). It was decided that we would include ALL educationally sound experiments, thus making it possible for individual physiology teachers from around the world to adapt two existing but out-of-date sets of laboratory experiments. The final product will be a collection of educationally effective, simple to do, and economical ideas for laboratory exercises. This new sourcebook will be available for free, on-line access from an American Physiological Society (APS) website. This project is being funded by a grant to Dee Silverthorn (Primary Investigator), Joel Michael (Co-Primary Investigator), and Marsha Matyas (Co-Investigator) from the National Science Foundation (NSF).

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teachers to pick those experiments that can be done in their particular institution.

We then turned to a discussion of how the “new” experiments should be formatted. Dee Silverthorn and Joel Michael proposed a template to be used, and this first draft was circulated. In the abstract, it proved very difficult to know whether the proposed version would work or not. We then looked at a single “old” experiment that Joel Michael had reformatted using the template. It was agreed that we would have to try using the template to actually redo a set of experiments before we could usefully consider alterations to it.

We divided into working groups each of which selected one experiment from the “old” sourcebook to rewrite. Four groups started work on experiments, including cardiovascular responses to cold, exercise, and cardiovascular experiments on Daphnia. Dee Silverthorn, Joel Michael, and Marsha Matyas facilitated the activities of the working groups. When the first drafts of the “new” experiments were completed, copies were distributed to the entire group. After the new experiment drafts had been read, there was a discussion of three different kinds of issues.

With actual examples of the template in use, we discussed changes to it that would be needed to make possible a product that would be most useful to physiology teachers. A number of significant changes were proposed and ultimately adopted. It was also acknowledged that we might need to make additional changes to the template as further experiments were redone and further deficiencies identified. We then critiqued the experiments that had been produced. This process proved to be very valuable in clarifying what information was needed in each of the slots in the template.

Next, we discussed plans and procedures for our postworkshop efforts. It was generally agreed that working together in groups to redo an experiment was helpful in that it brought to bear on the task diverse interests, knowledge, and experiences.

Fig. 1. The 2005 International Union of Physiological Sciences Teaching Workshop was held at Pali Mountain, California.

Fig. 2. An evening of work and s’mores around the fire in the lodge.
However, this was not intended to discourage solo efforts by those who prefer to work that way.

All working documents (files for the “old” laboratories, the template, and rewritten laboratories) will be posted to a website at the University of Texas maintained by Dee Silverthorn. All files to be posted should be Word documents. They must be e-mailed to Dee Silverthorn, who will actually put them on the website. Files on the website can be easily downloaded (go to https://webspace.utexas.edu/xythoswfs/webui/unglaub/iups-labs?).

To insure economy of effort, we decided that only one group should work on one of the “old” experiments. A “sign up” sheet will be on the website so that groups can indicate what experiment(s) they will be working on. Once a “new” experiment is posted on the website, it is fair game for criticism and commentary. Feedback should be directed to the author or team that produced the experiment. Changes to a posted experiment will be made only by the original producers of the experiment. Once final drafts of an experiment have been written, they will be submitted to the project editorial board for final vetting. When approved, they will be prepared as web pages and then posted on the APS website.

A listserv for communication about this project is being set up that will initially contain the e-mail addresses for all of the IUPS Teaching Workshop attendees (iups-labman@lists.cc.utexas.edu). If attendees have no interest in being involved in this project, they can unsubscribe.

After this discussion, the groups started working on second drafts of their first experiments. At least two groups began a second set of experiments, with each group selecting another of the “old” experiments to modify. We thus left Pali Mountain on Sunday with a workable (if not necessarily final) template and seven experiments in varying stages of development. We will continue to recruit additional physiology teachers to participate in this project. We will continue to rewrite experiments and prepare them for posting on the APS website.

**DISCUSSION TRACK II: INFORMATION TECHNOLOGY IN PHYSIOLOGY EDUCATION**

**Facilitators**

Tom Nosek and Usha Nayar

**Participants**

Jiri Kofranek, Osamu Matsuo, Sally Gauci, Jodie Krontiris-Litowitz, Adrianta Suradhana, Adam Watts, Dewi Irawati Soeria Santoso, Reonna Slagell-Gossen, Jeff Osborn, Nancy Pelaez, Melinda Lowy, Mariam Farmer, and Joyce Ono

**Day 1**

The participants in this track represented a diverse group of faculty working at both private and public institutions from around the world teaching undergraduate preprofessional/science students, undergraduate nonscience students, dental students, nursing students, master degree students, pharmacy students, MD students, and PhD students.

Access of students to computers varied widely: 1) all students are either provided with notebook computers or required to purchase a specific model computer and ubiquitous wireless access to the Internet; 2) there is adequate access through computer laboratories and in the library (the most common mode of access) with personal computer purchase NOT required; or 3) there is inadequate access (e.g., one computer with Internet access in the department office).

We discussed three expectations that are made possible by computer technology.

**Information on demand.** Information on demand included the following:

1. Course/subject information available 24 h/day, 7 days/week, and 365 days/yr.
2. Ability for students to utilize multiple intelligences.
3. Does this personal access to information encourage or discourage student-student interaction and student-faculty interaction?
4. Does this capability enable faculty to do something different with lecture/class time? This will put more pressure on faculty.
5. This will enable faculty to teach in a problem-based manner, freeing faculty to help students solve problems rather than giving them bits of information.
6. Students must be prepared for active learning in class, having reviewed the preparatory material before class. Student assessment of other students and peer pressure will assure students to come to class prepared.
7. Assessment of learning objectives will have to change. This resource makes possible open-book/open-world examinations.
8. Availability of such large amounts of information can lead to information overload. There is a need for learning objectives to help focus the students’ activities.
9. Students must be taught to evaluate the quality of the information that they have available to them.
10. Copyright issues.
11. Cost of student and faculty access could be an issue as we strive toward equity of access.

**Information just in time.** Information just in time included the following:

1. Retrieve information just in time to solve a problem. A faculty member could propose a problem and give students 15 min to work together, using ALL available resources, to solve the problem. This requires equity of access: all students must have computers and access to all learning resources.
2. Students must be taught the skill of quickly and efficiently finding pertinent information.
3. Faculty can focus on process rather than content. Make sure that the students have the tools needed to learn and turn information into knowledge.
4. If faculty cannot teach every fact, they must concentrate on what is important. Do we know what is important and what we should focus our teaching on? Is there a limited number of concepts/topics that we should assure understanding of rather than a large body of facts?
5. What is the cost of access to up to date information? Will this be a limiting factor for creating an “Informatics Culture?”

*Teaching physiology by laboratory experiences.* Teaching physiology by laboratory experiences included the following:

1. It was agreed that there is no substitute for “real,” wet
laboratory, physiological experiments for optimal student learning. However, there are obstacles to conducting these laboratories:

1. Cost
2. Ethical objections in killing animals for teaching purposes
3. Some experiments are too complicated to ever allow a large number of students to experience in a wet laboratory environment

Computer simulations can be used to prepare students for optimal use of “real,” expensive, and resource-intensive laboratories. These simulations can be introduced before clinical skills exercises are held.

Computer simulations save time; they do not require extensive setup time.

Computer simulations can allow the manipulation of variables that are impossible to change in a “real” laboratory environment.

Computer simulations allow students to explore procedures that are not appropriate in a “real” laboratory setting but that, nonetheless, are excellent learning experiences.

Faculty should define exactly what they want the students to get out of a laboratory experience. Then, it can be decided whether or not a computer laboratory or a “real” wet laboratory will satisfy those objectives.

“Real” laboratories lend excitement to the study of physiology. Ideally, both “real” laboratories and computer simulation laboratories (incorporating stochastic characteristics) would be part of the study of physiology.

Various topics. Various topics were identified for further discussions:

1. Does the use of information technology (IT) enhance student achievement? Research must be conducted in this area and made available to other faculty and administrators.
2. Technology equity is an issue. Ideally, ALL students should have a notebook computer and ubiquitous access to the Internet. This would change the nature of large and small group classes.
3. If students have access to Internet resources, how do we prevent plagiarism and manage copyright issues?
4. How can we create learning/teaching resources that are made available to faculty outside the creating institution? Can the APS be a repository of these resources?
5. How are faculty changing what they do as a result of IT?*
6. How are students changing what they do as a result of IT?*
7. How must assessment of student performance change as a result of IT?*

The group was divided into subgroups of four people each to discuss these last three topics (marked by asterisks), and they reported back to the group.

How are faculties changing as a result of technology OR how must faculty change to use technology in teaching? Barriers for undergraduate education include money (infrastructure and maintenance), infringement on faculty research time, and the need to impart change in methodology and pedagogy for use in the curriculum.

Methods and examples for change implementation include the following:

1. Summarize and/or list IT examples for use in curricular courses, e.g., identify available activities for course implementation.
2. Provide credit for promotion and tenure processes.
3. Must have research data to document what IT methods work in the classroom.
4. Develop collaborations with other faculties of universities and internal departments. Get the expertise that is needed and don’t reinvent any wheels, e.g., mathematics, computer science, educational psychology, curriculum and instruction, and multimedia art designers.
5. Develop shared contact lists for those choosing to include IT in their curriculums.
6. Utilize interested senior and/or retired faculty as resources.
7. Infuse departmental change by example; collect and obtain the data to document success.
8. Encourage IUPS to provide funding in technology implementation.

Develop alternative technology uses that ease changes in faculty teaching. Examples are hand-held interactive devices for large classroom teaching and the development of on-line/in-class data collection techniques to improve teaching pedagogy.

How are students changing as a result of technology? Educators must find the lowest common denominator, in both technology and student skill level, to operate effectively. Considerations include access to all material and software, usability, current software, and special needs students. Technology can change or affect students’ learning styles. Be aware of the consequences of labeling a learning style. Having a particular learning style should not be used as an excuse for not learning the material.

Positive aspects that were identified include:

- Information on demand. Flexibility. Instant access. Students would engage with the material the way they want it, when they want it.
- Easily available to many current resources.
- Dynamic resources.
- Accessible to different learning styles.
- Learning tools.
- Facilitates more student-centered learning.
- Virtual community of distance learning.
- Allows introverts to “speak up;” requires all students to participate.
- Deeper learning due to longer time frame of thinking to respond to chat for example. More reflection.
- Easier editing of reports by the students.
- Can be more anonymous; may prevent intimidation.
- More interactive.
- Allows for students to assume more responsibility for their learning.
- May cater for special need students, i.e., those hearing or visually impaired.
- May improve communication skills (writing) and other generic skills
- Technical skills, e.g., e-mailing, using software, surfing, and advanced searches.

Negative aspects include:

- For some students can mean laziness or nonattendance.
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- Less engagement.
- More unreliable resources available. Disadvantages students who cannot critically evaluate.
- Easy to copy and paste from the internet; plagiarism.
- Surface learning for some students; no synthesis.
- Too overwhelming.
- Student may demand or expect more from educators. More “edutainment” with more resources, e.g., cell phones, games, and chatting. Not in touch with reality.
- False impression of what is acceptable.
- Remove face-to-face teaching, resulting in isolation.
- Prevents quick thinking.
- Has the potential to inhibit original thinking.

How must assessment of student performance change as a result of IT? The following questions arose during discussion: Can we assess the value added using technology? Can we use IT for assessing student learning (competence levels)? How can IT be used for assessing skills, behaviors (e.g., student study behaviors), and attitudes (confidence)? How can IT be used to evaluate and provide feedback to the teacher about teaching performance? and What is the merit of IT as an assessment tool?

The group concluded that the merits of using IT for assessment of learning include the following items:

- Person-to-person contact will always be the best assessment. The role of technology is to make assessment more efficient and support the human-to-human interactions. In a high-tech world, assessment without technology is disconnected from a students’ real world.
- If the assessment is recorded, it can serve as documentation of the teaching process and provide the opportunity for reflection, evaluation, and improvement.
- Immediate feedback is available.
- Collaborative efforts across distance and time can be pulled together.
- Versatility: the technology presents many opportunities for multiple dimensions and increased complexity. Because of its multiple dimensions, it improves the way humans assess (e.g., you can stand “next to” a student during a patient interaction in a way that would be inappropriate for a face-to-face format).
- Time management.
- Sharing of efforts: material created by one faculty member can shared, replicated, and improved by others without additional cost.
- It closely represents what the student will find and use professionally and so it prepares them better for their future technical skills.
- Formative feedback: the same material can be examined from different perspectives multiple times.
- Peer review and self-assessment (the progress test).
- Technology helps you correlate performance outcomes with your planned objectives and get a better idea about whether the goal was met to make adjustments.
- It supports your evolution throughout the teaching process, including improvement of assessments.
- Limitations were also identified. Plagiarism can be a problem. Careful design of assessment tasks is needed to encourage students to construct and synthesize meaning instead of simply copying information from the web. No system will reach universality, i.e., there is no technology equality. Human beings must design assessments that IT can do.

Day 2

Day 2 of the IT track of the Workshop started with a discussion of the properties of an ideal physiology curriculum given the capabilities of IT.

1. IT allows multiple approaches to teaching a particular topic, customized to accommodate all learning styles.
2. IT has the capability of motivating students to want to learn the material.
3. Hyperlinking to background material is possible, providing remedial material and review material for students who need it.
4. Use of resources such as WebQuest, which allows for on-line discussions of results.
5. Continuous formative assessment is possible.
6. Asynchronous, self-paced learning is possible, with summative assessment when each student is prepared for it.
7. Information is at your fingertips due to the capabilities of IT. However, information is not knowledge. IT skills are necessary for life-long learning to be realized.
8. Some of the skills that must be acquired by the students are PubMed searching, Web searching, graphical representation and interpretation, statistical analysis, and simulation analysis of systems.

We introduced a model of teaching physiology that could be conducted either locally or via distance education.

1. Students are introduced to topics by lecture. Learning objectives are provided to the students.
2. Learning of the topic takes place by completing exercises and conducting experiments on physiologic simulations either alone or in small groups. The time allotted for these activities varies by the topic and extent of the learning objectives.
3. Formative quizzes are available for students to assess learning.
4. Students come together to discuss the results of their exercises and simulations. Faculty make sure that the learning objectives are achieved.
5. Summative assessment is done at the completion of each block.

The large group broke into three subgroups to propose learning models for the future, all or part of which may be adopted be various courses at various institutions: Group 1 proposed the scientific study of various aspects of the model of using IT in education. Their research questions were as follows:

1. Value of using physiological simulations/models to understanding physiological processes [either using large-scale mathematical modeling (Czech model) or simulation/animation modeling (Melbourne model)].
   a. Student happiness/satisfaction/inspiration for further study.
   b. Performance on equivalent of the National Board on that topic; internal examinations.
c. Bank of higher order/applied/transference of information.
d. Effect on retention throughout the course/medical training.
2. Do running experiments with simulations and requiring students to graph the data and statistically analyze it increase their graphical/statistical skills?
3. Will making these simulations “Open Source” lead to greater use and increased sophistication?
4. How well do students perform working at their own pace? Are required formative experiences necessary to keep students on schedule?
5. Are the “nodal” points where faculty and students physically come together an essential element of the model? Is the value dependent on the content of these physical meetings?
6. The syllabus for this modeled course would be web based. It would contain exercises that require the students to
   a. Conduct a PubMed search of the current literature
   b. Find and evaluate the appropriate websites.
7. Do these exercises enhance the students’ ability to conduct literature searches and find and evaluate the appropriate websites?
8. Does the use of hyperlinking within the on-line syllabus enable students with background deficiencies perform better in the course?
9. How involved does the professor need to be with the students between “nodal points” for the course to be effective? Are office hours/chat groups/blogs/threaded discussions (either physical or electronic) necessary?

Group 2 decided that the time has come to initiate research projects to guide us for further use of IT in a more rational and cost-effective manner (considering the costs in terms of both time and equipment). Approaches include the development of evidence-based IT use by studying the ways IT facilitates the teaching and learning process and identifying the negative aspects. The group decided to develop a questionnaire to survey the Pali Mountain faculty about the following questions:

1. What are the concerns people have about use of IT in physiology education?
2. IT is not being used by many faculty members. What are the attributes of IT-supported education that should be recognized by all faculty?
3. In physiology, what are people doing with IT to facilitate learning and assessment? Document the best practices.
4. How does IT-based instruction change the learning environment?
5. How does IT help students learn things in physiology that they could not learn without IT?
6. How does IT influence student attitude and their approach to learning?
7. What uses of IT help students become independent learners?
8. What uses of IT help students judge their own progress toward instructional goals?
9. Can we develop a (taxonomy) classification of domains (sphere of influence, realms) where IT supports for the educational process (the Pali Mountain taxonomy).
10. Is it true that IT facilitates learning? Retention, willingness to spend time, attitude.

Survey questionnaire: the Pali Mountain taxonomy. The group hopes to collect data to construct the taxonomy from teachers of physiology from around the world. The following questionnaire was developed:
Please answer the following questions to help in the development of a taxonomy (classification) of domains (spheres of influence, realms) where IT best supports the physiology education process.

1. How do you use IT to facilitate learning or assessment? List your three best uses.
2. How has IT-based instruction changed the learning environment in your classes?
3. What are the attributes of IT-supported education that you value most? List and explain.
4. Do you use a course management system? If so, state which one and tell how you use it in physiology education. Is it required and has it been effective?
5. Has IT helped your students learn things in physiology that they could not learn without IT? If yes, please give an example. If not, explain the reason.
6. How does IT influence student attitude (satisfaction, motivation, confidence, and wanting to know more)?
7. How does IT influence your students’ approach to learning?
8. Does IT help your students become independent learners? Explain.
9. In what ways do you feel that your use of IT helps students judge their own progress toward instructional goals?
10. What are your concerns about the use of IT in physiology education?

Nancy J. Pelaez (College of Natural Science and Mathematics, California State University, Fullerton, CA) has put the taxonomy on the web at http://scied.fullerton.edu/PaliMtTechSurvey.htm.

Group 3 asked how embedding IT into the physiology learning process impacts student learning. They concluded the following:

- One cannot develop a generic model.
- Technology should be utilized to enhance learning, not just because it is there.
- Technology needs to be embedded in the curriculum, not just “bolted” on.
- One cannot find a common standard to judge everyone.
- IT has to make sense in your own objectives (“constructive alignment”).
- An assessment task is needed with each activity or usage of technology.

DISCUSSION TRACK III: CURRICULUM PLANNING AND DESIGN

Facilitators
Beatriz Ramirez and Bill Galey

Participants
This track was attended by 13 individuals from 7 different countries.
This is a report of the main points discussed over the course of the workshop. Essentially, all final conclusions were the consensus of those present. While it is difficult to accurately convey the course of discussion, the subtleties of meaning, and the mood of the discussions, we hope this rough outline provides the reader a sense of the exciting discussions that took place.

After an initial brainstorming session, five main topics were identified for further discussion. These were the following:

1. Learning objectives
2. How do we teach to achieve our learning objectives?
3. Assessment of students and out teaching
4. Is physiology an independent discipline?
5. Strategies for changing a curriculum

Although we are unable to reconstruct the complete sequence and content of the discussion, we outline here the principle issues discussed and general conclusions reached within each of the five topics. They are presented here in the order in which they were discussed.

Learning objectives. It was agreed that general and specific learning objectives must be included in each course’s curriculum. However, every course will have different specific objectives determined by the interests and needs of the students enrolled in the course (biology, zoology, dentistry, medicine, etc.) or their academic level (basic, professional school, graduate, postgraduate, etc.). However, it was concluded that there are some general principles that should be found in all physiology courses. While not all of the objectives were addressed completely, the following general objectives were considered essential for any physiology course:

a. Learning should be applicable to the students’ daily life or career. (This increases comprehension and facilitates the learning process.)

b. Understanding the main (basic) themes (basic concepts such as homeostasis and control of processes must be learned by all students).

c. Understanding that body systems are not functionally isolated is also core to all physiology courses. Despite usually being studied sequentially and separately, they function as an integrated whole to maintain body homeostasis.

d. Students must be challenged to learn to process and integrate information because useful learning in physiology is more than an accumulation of information. Participants discussed how students must process the new information and integrate it with their previous knowledge to construct their own understanding as to how the body functions.

e. Every physiology course should provide opportunities to analyze and evaluate both learned information and physiological data. It was agreed that data analysis provides a different learning modality than the evaluation and integration of the conceptual information. Searching for useful information in the literature, in one’s own fund of knowledge, or in other resources that are relevant to a challenging physiological problem was not only considered a unique learning tool but also an exercise worthy to be considered a course objective.

How do we teach to accomplish our learning objectives? The main target for an effective learning process is the intellectual engagement of the student. Among the approaches discussed that were believed to achieve that goal were active or student-centered methodologies such as problem-based learning (PBL), inquiry, and self-directed learning. A more unusual but exciting approach is the development of models to explain sets of physiological observations. It was also agreed that it is particularly useful to use examples in lecturing that are applicable to students’ daily lives as was helping students to consolidate their understanding by posing interesting problems (questions) that require the use and integration of their knowledge.

The participants agreed that engagement of students can be attained through a variety of teaching modalities, including lectures, practical laboratories, group-based/peer learning, case-based/PBL, tutorials, consultation time, computer-aided learning, and one-on-one interactions. Not one of these approaches was rejected. Moreover, it was considered that “mixed teaching modalities” are good for maintaining the interest (and also the engagement) of the students over a long period of time. However, it was emphasized that active participation of the students was a “must,” even in lectures. In this connection, lecturers should recognize that after few minutes of even the most engaging lecture, the audience’s concentration decreases. Therefore, lecturers should apply teaching tools to maintain the students in an “active learning” state throughout the lecture period.

In laboratory experiences, active participation of the students was recognized as mandatory, and the use of “cookbook” exercises where students merely follow a series of instructions was rejected as they do not usually engage the minds of the learners. The utility of good laboratories for the acquisition of skills (particularly analysis and evaluation of data) and appreciation of research was recognized but was considered by the discussion participants as essential for only some courses. Therefore, a careful evaluation of the cost/effectiveness relationship of laboratories was recommended before incorporating them in a course.

It was suggested that, when available, an assessment of the students’ preferred learning styles (such as VARK) in any particular class can be useful in selecting the most effective teaching techniques for the class.

Assessment. It is well known that learning is generally driven by assessment. Therefore, the assessment of student learning must be aligned with the learning objectives of the course. There are several types of assessments that can be made and each serves a particular purpose. These assessments include the following:

- Baseline knowledge assessment to test starting knowledge of the learners.
- Formative assessment, which provides feedback to students as to how well learners are mastering course objectives and allows them to improve their performance.
- Summative assessment to document and certify the achievement of the learners in the course.

The discussion participants recognized that it is not always easy to answer the question “What should be assessed?” because knowledge, competence, behavior, and skills (mental, manual, and communication skills) can all be submitted to assessment. It was concluded that 1) assessment depends primarily on the learning objectives of the course, 2) all the objectives should be evaluated, and 3) the education processes...
used by the instructor of the course should also be evaluated. It was concluded that not only should student performance be evaluated utilizing a variety of tools but also the effectiveness of course itself should be evaluated.

With respect to the course evaluation-utilizing questionnaires, it was proposed that it is often useful to obtain anonymous student opinions before final student assessment as the results of the evaluation may be biased by the perceived difficulty of the assessment. In addition to student opinion, other systems of assessment of the course should be used. These include peer evaluation by other teachers, followup of the student’s performance, inquiry of employers or subsequent teachers, and comparing student performances with national averages on standardized examinations. The accreditation process that is currently being done in some countries for accreditation of departments (teaching and research facilities), teaching faculties, universities, and professional careers was also identified as a type of evaluation for physiology curricula.

Physiology as an independent discipline. The question was raised as to whether physiology should be taught as a unique course of study or integrated with other courses in medical schools. This is of particular interest and importance as modern medical education has moved (in many countries) toward simultaneous, integrated teaching of all the basic medical sciences. It was generally agreed that the importance of physiology as the primary integrative biomedical science and its relevance to pathobiology and medicine means that the adoption of an integrated curriculum is not generally detrimental to the presentation of physiology. However, strong advocacy is needed on the part of physiologists to ensure that the important unique physiological principles such as those mentioned above are incorporated into the core curriculum and not assumed to be covered due to the pervasive nature of the discipline in the integrated biomedical sciences. Furthermore, physiologists should be vigilant to ensure that the multisystem nature of the human body’s responses be appreciated in what are commonly individual organ system organized curricula. Discussants agreed that it is currently not possible to separate physiology from other disciplines such as biochemistry, cell biology, or histology, because all use the same technologies (molecular biology, proteomics, genomics, etc).

It was recognized that although physiology is currently not as “fashionable” as molecular biology or cell biology, its importance to the understanding of medicine is clear and that the application of the new findings of modern biology will require their integration into the physiological knowledge base. Although it was a recognizable biased group, the participants were optimistic about the future of physiology as a discipline both in teaching and research.

Strategies for changing a curriculum. Before a fundamental change in a curriculum can be initiated, whether for a course, a series of courses, or professional training, the need for that change must be justified. Even if the need for change can be demonstrated, the likelihood of success of new curriculum must be carefully evaluated. It is important to consider many aspects of the proposed change including administrative support, adequacy of facilities, teaching skills of the teachers, consensus for change (colleges, students, and administrative authorities), and financial resources available to accomplish and sustain the curricular modifications. In any case, inadequacies of the current curriculum should be identified to define how to improve it.

It was generally agreed that changes should be supported if they increase student participation in the learning process (increase active learning or student engagement). Any curriculum should be constantly evaluated so that it can be adjusted to the needs of students, faculty, employers, and society. If there is a need to change, the new objectives of the course should be clearly defined. Also, teaching methods and student assessment should be aligned with the new objectives.

In summary, the curriculum should be periodically evaluated and modified accordingly to meet any reasonable changing need.

DISCUSSION TRACK IV: ISSUES IN CLASSROOM TEACHING

Facilitators

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Participants

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Interests of Group Participants

During introductions, the group shared their interest in participating in this group. Their student-oriented interests included approaches for engaging students, improving their learning, and dealing with diversity of student expectations for their own learning. The group also was interested in discussing ways to teach students to conduct research.

The faculty-oriented interests included ways to train current and future faculty members to teach effectively, to facilitate workshops, and to facilitate PBL sessions. Other interests were how to align assessment to learning objectives and pedagogy, and how to “cover” the material with more active learning included.

The faculty- and student-oriented interests included how to make lecture classes more active, how to help students learn how to learn, and how to use and design student evaluations.

How Do We Engage Students?

Students are diverse in what they want out of your class, i.e., some students just want to pass and some seek deep understanding. How can you change student attitudes? Ideas included not using grades and designing assignments that are student driven and not stick driven (students would be more likely to accept the task).

Teachers may use the following:

- VARK (at http://www.vark-learn.com) for students to self-assess their learning styles and best ways to study. Explain to the students why you teach the way you do.
- Canned interactive learning packages like Brainstorm can be improved by adding a concept map or summary diagram for students to synthesize and organize what they have learned.
- Computer-aided learning to complement lectures.
Meeting Reports and Announcements

- A 10-min problem in the middle of the lecture to introduce the next concept in the lecture; if not graded, then this is relatively safe.
- The 30-s rule when asking thought questions in lecture (wait 30 s for a student from the class to volunteer an answer).
- Random attendance checks with some reward as a formative assessment.
- Princeton-style shotgun seminar design: where the students are given a problem or case and told to be ready to present whereby one person is selected at the next class session to present.

Other suggestions included the following:

- Calling on students by name but using at least three names at a time.
- Replacing one lecture a week with a case or problem-based activity.
- Giving students an experimental question during a lecture and having them come up with the experimental design and predicted results and how to analyze the results by incorporating potential graphs for the data.
- Incorporating into lectures compare and contrast activities, puzzles and problems, and breaking complex questions into simpler steps and soliciting answers.
- Having students in a workshop setting answer predetermined faculty questions with Powerpoint slides and textbooks available.
- Incorporating case analyses of diseases.

Do We Value Different Learning Preferences?

Medical students are more homogeneous than undergraduate students, and the designing of a class for undergraduates should include more recognition of multiple learning preferences. Thus students can be sent to www.vark-learn.com and report their preferences back to the class. One needs to understand how the students think to design the course appropriately.

How Do We Use Handouts?

Handouts were discussed and how they are used. Are they passive versus active, details versus summaries, or outlines? Some give PowerPoints before lecture and annotated PowerPoints after lecture. How do we get the students to realize that taking notes themselves is a good learning technique?

How Do We Choose and Use a Textbook?

Do we assign readings from the textbook, and how do we encourage the students to do the readings (carrot vs. stick)? Should highlighters be banned? In a PBL setting, it is good for students to have different textbooks because they share their information on different terminology and learn better from each other.

How Do We Deal With Student Retention?

Why do students leave during the first year, and what is an acceptable percentage failure for first-year biology courses? How do we convince our business offices that the students should be failing and/or dropping out at a rate of 20–30% in introductory biology courses? First-year seminar courses are designed to help students adjust to college life. For social adjustment, they can live in communal housing, or the faculty can form working groups in their courses. Some institutions allow trying out a course before final enrollment. Observe students in action and what they are doing and how they are learning. There needs to be some linking of K–12 requirements to postsecondary requirements. Survey students early in a course to see what their career goals are and design activities to address these. Low-end science students are where we need to increase engagement. Determine how the course is relevant to them: use cases, articles, and graphs from the current news and current ethics issues related to them, be sure to allow the students to argue from all sides during biomedical ethics activities, and have in-class or on-line discussions of others’ opinions. Use humor to increase the comfort level of the class. In choosing laboratory activities, be sure to choose laboratories that teach concepts that are relevant to student career choices (clinical emphasis for medical students, for example) or real-life research to teach the process of scientific investigation.

How Do We Teach Students About the Research Process?

At Adelaide, students do a miniresearch project including a presentation using themselves as human subjects during the second year and work in a research laboratory for an entire year during the third year. If honors students work an additional year doing honors thesis, problems can arise with logistics and staffing. Reasonable time requirements should be established. After more formalized teaching of research skills, one can give an exam where the student needs to design an experiment and predict results. Whenever possible, laboratory activities should be correlated with lecture (taking advantage of the K of VARK). Begin the development of research skills with guided inquiry. Laboratories can be very useful with little equipment, but you still need space and staff. Learning outcomes should include both content-led and process-driven knowledge and skills; some should also evaluate problem-solving skills.

How Do We Train Teaching Assistants?

Some of the ideas brought forward were the following:

- Regular, weekly tutor-training meetings.
- Workshops on ethics of research and potential class problems.
- An induction session of a full week before classes start.
- On-the-job observation and feedback or a practice teaching session with videotape.
- Specific training for the laboratories.
- Training on how to ask effective questions instead of just being an imposter of knowledge.

All those teaching in a given curriculum should have regular casual meetings to share ideas and problems related to teaching, and these should be counted as teaching time. At www.the-aps.org, there are numerous resources for skill training for future faculty and for approaches to education at all levels.

How Do We Deal With Student Expectations as to What Should Be in the Course and How Demanding It Might Be?

It is helpful if the faculty member is of the chosen profession of the student or knows about the requirements of the profes-

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sion so that students feel more confident in what they are learning (for example, a medical school faculty member teaching premedical students).

Do Faculty Who Use Active Learning Shine With the Students and Do Colleagues Notice?

New faculty and graduate students should be encouraged to observe other faculty to glean teaching ideas. Institutions have some required peer evaluation of nontenured faculty like East Carolina, where three times during the pretenure period two senior faculty observe teaching and give constructive criticism; their report is put in the tenure packet. Peer evaluation visits may be announced or unannounced. Faculty can also do self-evaluation of a videotaped lecture, which may be very painful!

How Do Institutions Recognize the Scholarship of Teaching and Educational Research?

It is helpful if promotion and tenure guidelines have a broad definition of scholarly activity, but still one needs to submit an evidence-based teaching portfolio that incorporates educational research and grant writing, not just innovative curricular design. One should add reflections and responses to suggestions from students to one’s teaching portfolio with references that document one’s understanding of the educational literature. Recognition outside one’s institution (such as being involved in an IUPS Teaching Workshop in a leadership role) and earned certificates are useful as evidence of scholarship.

How Are Student Evaluations Used?

Students can be asked to evaluate courses and individual faculty. Issues for faculty evaluations that were identified included the following:

- Overemphasis by deans of the value of individual student criticisms.
- Use of on-line versus paper formats.
- Use of standardized versus flexible survey instruments.

There are major cultural differences in acceptance by faculty of student evaluations of their teaching. The following suggestions were made about the process of getting evaluations:

- Ask for input on specific components/activities in the course.
- Bribe students with pizza to fill in evaluations.
- Use a participant perception indicator that allows students to evaluate before, midway, and after a course based on the objectives of the course.
- Let students know that changes have been made as a result of evaluations.
- Use multiple forms of evaluation.

Formative evaluation should be used frequently with feedback to the students. Student self-evaluations may be useful in formative evaluations. The Student Assessment of Learning Gains survey is available on the web from the University of Wisconsin at Madison, WI.

When should evaluations be scheduled and how can teachers get students to fill them in? Consider giving significant time during the course (15 min) BEFORE the lecture starts. Use WebCT and do not release the student’s grade until their evaluation is submitted.

How Do We Help Other Faculty Become More Effective Teachers?

Comments included having informal discussions around a meal and involving administrators or course directors to support removal of an inadequate teacher from a course if he or she refuses to try to improve. Have course directors evaluate teaching of all members of the faculty team and evaluate student learning on systems via a shelf standardized exam. Sign up for IAMSE webinars at www.iamsese.org; these are monthly internet seminars for teachers of medical students.

How Are PBL Facilitators Trained?

PBL facilitator training includes how to facilitate and ask probing questions, specific problems that might occur with the case, complete tutor guides, and lots of role-playing of various levels of PBL groups. In addition, faculty can be encouraged to use resources from their university’s Center for Teaching and Learning to strengthen their skills in teaching. Use of videos about small group management with good and bad facilitation can be useful to introduce to faculty. Who can facilitate PBLs? Clinicians, basic scientists, PhD students, retired faculty, and advanced students. When tutors are paid, they are more likely to participate and be prepared. The best way to learn how to do PBL is to visit an institution where it is being done and observe the groups in action. PBL facilitators should be required to attend training. Perhaps there should be a PBL demo on the stage at the Federation of the Asian and Oceanian Physiological Societies along with a keynote presentation to all participants on educational theory to show how it works.

How Do We Deal With Assessment?

A full range of issues and ideas emerged from the discussion: use of multiple-choice versus essay questions; evaluate generic skills like critical thinking with short answers and essays, analytical writing, presentations, and models; use never-before-seen questions for 10% of an exam; assessments should match the question format that the students are familiar with; have marking calibration workshops for the teaching assistants before their grading assignments for a course; have an outside expert analyze the exam for accuracy and relevance to the field; have the students revise and resubmit papers; use student peer marking (use Calibrated Peer Review through the University of California-Los Angeles website or faculty need to look over peer reviews by students); use standardized exams that are externally constructed and nationally calibrated; rewrite original articles from popular press; students should get a chance to practice answering exam questions like the clinical vignettes of the United States Medical Licensing Examination Part I; oral interviews would be useful but are currently rarely used; self-assessment tools and exams help students know areas of strength and weakness and the limits of their knowledge; and pre/posttests for evaluating student learning in each section of the course.

Some techniques other than exams can be used: poster presentations, other types of presentations on the web or for the community, contributions to the PBL group, literature reviews, laboratory reports, community service reports, and related job experience.
How Do We Determine What Content to Include and What Not to Include?

If there are no external curricular guidelines, this will depend on skills and interests of the faculty, what is fun for the faculty and students, and relevance to students’ career goals. Participants agreed on the benefits of sacrificing rote facts for concepts: students should be told to learn certain facts on their own. Other strategies are to use common diseases to determine content and to use a core curriculum, if one is available, for quality control.

GRANTS

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