Infrastructure for Laboratory Distribution

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Abstract

Though laboratories are an important element in student education, the development of effective labs is impeded by several factors: (i) the present academic reward system does not encourage or promote laboratory development time; (ii) there is no mechanism in place to distribute labs; and (iii) there is no mechanism in place to review or recognize appropriate lab assignments. We propose a laboratory distribution system that allows labs to be developed by faculty members at different universities, reviewed by an external review board, and then cataloged and stored for use by faculty at other universities. This system benefits the author of the labs (recognition, feedback), the other faculty that use the lab assignments (decreased preparation time), and the review body (fosters cooperative environment among universities, insures laboratory “quality control”).

1. Problem Statement

Labs are an important element in student learning. Effective laboratory exercises can spark learning in students, correct conceptual misunderstandings, and help students adjust quicker to the work environment. (If a student has already used specific hardware and software tools in a university, then he/she will not need to be trained to use them on the job.)

Though laboratories are an important element in undergraduate (and graduate) education, development of effective labs is hindered by a number of factors. First, there are competing, and at times overwhelming, demands on professors’ time. The promotion and tenure system rarely, if ever, rewards time spent developing and revising undergraduate laboratories.

Second, there is not an agreed-upon method of distributing/publishing laboratory exercises. For course content, there is textbooks. For research, there is refereed journals. But there is nothing comparable for labs. There is no way to contribute and share educational materials. A corollary is that there is no common format/publishing standard for labs. Thus, even if someone wanted to share lab modules, there is no mechanism for publishing or distributing the information.

Third, there is not a uniform method of recognizing and reviewing undergraduate labs. Labs are not “reviewed” to ascertain (i) their applicability to the material, (ii) their educational/learning value, (iii) what resources are required, (iv) the time involved (pre-lab, during lab, and post-lab), and (v) their stimulus for creative thought on the part of the student.

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<th>Hindrances to development of effective labs</th>
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<td>Lack of reward for professor’s development time</td>
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<td>No mechanism for distribution</td>
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2. Proposed solution

A proposed laboratory distribution methodology is given in Figure 1. The process starts with faculty from different universities creating laboratory assignments. The assignments can be designed to conform to a style standard set forth by the review organization. The standard might require sections like: goals, skills developed/learned, prerequisite background required, equipment (hardware/software) required, problem statement, expected results, etc. The review organization that develops the standard would be a committee (or committees) of volunteers operating under the auspices of the IEEE or similar national organization. Faculty developing labs can then submit their labs to an external review board whose task it is to insure the quality of laboratory assignments and enforced the style standard. This system is essentially the same as a peer review system for research/journal paper submission. Accepted labs are then sent to a publisher who catalogs the labs and stores them in a database. Lab catalogs are made available to instructors allowing them to select labs pertinent to their curriculum. The publisher will then assemble lab manuals for use in the classroom and distribute them for sale.
In preliminary discussions with one publisher, this idea seemed to be quite feasible provided materials are prepared in electronic format for cataloging purposes as well as for storage and inventory reasons. Typically labs are created in electronic format, so we don’t really see this as a problem. An electronic format standard would also make it easy to search databases for labs available via ftp or the world wide web. Some electronic distribution method could certainly be developed to reduce publication cost, but it is still important to screen labs submissions and insist on quality.

3. Benefits

The laboratory distribution system that we proposed in Sect. 2 will benefit all the parties involved. The original faculty authors will receive recognition in the form of feedback from the unbiased review board. If the review board accepts the lab exercise, then it is external confirmation of the thought, creativity, and work put into developing the lab. In addition, the author would receive feedback on his/her labs (both from the review board as well as others who might use the lab) so that the lab could be modified or improved.

Faculty at other universities would have access to a database of innovative labs. If the lab “database” is online, then the database can be searched for labs that are relevant based on one of several criteria. For example, presumed knowledge of the students, available laboratory equipment, in-class time available, and/or fundamental concept. This would greatly decrease preparation time for faculty.

It is presumed that the review board would be governed by either the IEEE or some other national body (e.g., ACM, ASEE). Our proposed system will allow the national body to build a laboratory infrastructure. This infrastructure will foster a cooperative environment among universities. It will also impose a certain “quality control” on the laboratories since the labs will be in a standard format and reviewed for overall quality and depth. This will lead to an overall improvement in laboratory instruction in the universities.