Teaching in Contemporary Forest Resources Curricula: Applications to Courses in Forest Measurements and Biometrics

Contents

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Introduction

Foresters face new and evolving challenges as society reconsiders the balance of its interests between wood production and the provision of ecosystem services in the management of forests. Whatever paths this process may take, sound and broad-based decisions will continue to require accurate and relevant measurements of current forest conditions and projections of future conditions under alternative management programs. Forest measurements and biometrics (FMB) will remain a key component of future forest management and a critical element in the education of future forest managers. As professors who both teach and do research in FMB, we offer teaching goals that we believe will improve FMB education in forestry schools to meet future needs.

In the following sections, we outline teaching goals for university-level instruction in forest resources curricula and the roles of FMB in modern forestry. We then identify what we feel are the most critical challenges in teaching and learning FMB and discuss selected strategies to meet teaching objectives for FMB. A fourth section presents an overview of how selected strategies can be integrated into FMB classes, including examples and comments on the role that new technology might play in meeting the above-described challenges. The final section summarizes our main points and provides concluding remarks.

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1 Teaching Goals and the Roles of Forest Measurements and Biometrics (FMB)

1.1 Teaching Goals in Forest Resources Curricula

In addition to understanding the specific topical material in forest resource curricula, we believe there should be three over-arching teaching goals for the instruction of forestry courses: communication skills, critical thinking, and job preparation and lifelong learning.

1.1.1 Communication Skills

Communicating effectively is the hallmark of any professional. Heavy use of subject-specific jargon can be a deterrent to the application or appropriate use of research results or findings. Forest resources courses should teach students to become articulate with methodology and proficient in giving advice in a clear and succinct manner. To this end, forest resources courses should provide students with the opportunity to practice communicating concepts and results in written reports, oral presentations, and interpersonal communications.

1.1.2 Critical Thinking

Learning characteristics of undergraduate students have changed over time. With limited time to reach students, lessons/labs of forest resources courses must be properly designed to engage students and carry them along to reach specified goals. With a lecture-based, teacher-centered approach to content delivery, developing independent thinking and learning skills becomes the domain of the laboratory exercises. However, to significantly increase the students' skills in problem solving it may be necessary to change the format from a teacher-centered approach to a student-centered approach, in which the instructor becomes coach instead of lecturer.

The importance of critical thinking can be demonstrated with an example from FMB courses, in which students need to develop critical thinking skills in order to be able to plan inventories and choose the most suitable sampling design for a specific objective. Exposure to the thought process that takes place when designing a natural resource inventory will help students acquire critical thinking skills. Critical thinking is also required during the data compilation process in FMB courses. FMB students should learn how to test their theories, and detect errors and inconsistencies in their calculations. They should get into the habit of critically questioning values that they report, and they should become accustomed to the range of variability of likely outcomes. For example: Do the volume estimates make sense? Do basal area per unit area, trees per unit area, and volume per unit area estimates match? Do the estimates seem reasonable considering what was observed in the field? This ability transforms the exercise from a math problem to a real-world problem.

1.1.3 Job Preparation and Lifelong Learning

Forest resources courses should teach students basic concepts needed for entry-level positions while establishing a foundation for lifelong learning. We believe that one of the most important aspects of being a professional is also that of being a lifelong learner. Increasingly competitive job markets and the need to keep up-to-date professionally have made learning and acquiring or improving skill sets an ongoing process. Being a lifelong learner is crucial in the context of changing and evolving technology and societal values, and opens doors for numerous possibilities to improve forest management and the delivery of our services to society. As a result, educators should inspire their students to become lifelong learners and to share their knowledge with others. At the same time, universities must continue to offer educational opportunities for mid-career professionals.

1.2 Roles of Forest Measurements and Biometrics (FMB) in Forest Resources Curricula

Forest measurements and applications of biometrics are so basic to forestry activities that nearly all management professionals need some grounding in fundamental methods and concepts to be effective. The learning outcomes associated with FMB activities provide common threads between the many sub-disciplines in forestry (e.g., silviculture, economics, ecology, genetics, tree physiology, wood technology). All depend on reliable information about forest conditions and, in applying their specific disciplinary expertise to management problems, all need the ability to project future forest conditions as management inputs and/or the external environment changes. To retain a useful role as provider of fundamental knowledge and skills, FMB in turn is constantly evolving to insure the relevance of the information available, refine and improve its quality and reduce the cost of its collection and development (Temesgen et al. 2007). Reliable quantitative data, coupled with sound judgment, are central to prudent decision making.

2 Challenges in Teaching and Learning FMB

We believe that there are three particularly critical challenges facing teachers of FMB today: inadequate student preparation in quantitative and communication skills, motivating the necessity of lifelong learning, and application of effective methods of student performance assessment.

2.1. Lack of Basic Skills

It is extremely challenging for students to learn FMB if they are ill-prepared in basic skills of mathematics, statistics, computer applications, and communication. The lack of these preparatory skills leads to FMB educators spending a lot of time on reviewing prerequisites, which results in students focusing on catching up instead of concentrating on the FMB concepts.

In recent years, FMB students have struggled with basic algebraic concepts that FMB educators should be able to expect in a junior-level college class. For example, calculating the area of a circle, something a forester needs to do on an everyday basis to calculate the basal area of a tree or to calculate the area of a circular fixed-area plot, has proven to be difficult for many students. Students who struggle with these concepts spend most of their time learning the basic mathematics rather than the FMB concepts taught in class.

To simplify the process of data compilation required for FMB classes, many FMB educators have their students use spreadsheet software. Typically, as part of their homework assignments, FMB students need to compile tree-level data as well as plot-level and stand-level summary statistics and create graphs of diameter distributions and stand and stock tables. Despite exposure to computers and computing throughout their pre-college years, many students possess only limited knowledge of spreadsheets at the beginning of an FMB class.

Some end up spending too much time wrestling with the spreadsheet software to generate the required output which, again, distracts them from grasping the key concepts of data compilation.

Poor student communication skills, particularly their inability to express their thoughts in writing, provide another challenging aspect in teaching and learning FMB. For example, students are commonly required to communicate their cruise findings in standard report form, including introduction, methods, results, discussion, and conclusions sections. Some students are overburdened by this format, do not know what belongs in the different sections, and are unclear about the degree of detail appropriate in different sections. Incorrect grammar, innumerable typographical errors, and colloquial writing style make it difficult for the instructor to determine what the students are trying to say in their assignments (and exams) and whether they have understood the material. As a result the mensuration class becomes a remedial writing class.

2.2. Motivation for Lifelong Learning

FMB educators need to teach students to perform well in their entry-level positions (jobs) while simultaneously laying a foundation for their future careers (for the next 20 years or more). Motivating students, even those unprepared for the math or statistics, for life-long learning is the biggest challenge. Helping students recognize the need for a career-long process of updating and learning requires exposing them to the literature and teaching them how to use different resources to learn about specific topics and solve problems by themselves. However, some students appear to be averse to reading and many have developed a fairly rigid view of what they should be expected to do to demonstrate their grasp of a concept or method. Indeed, by the time students start college many expect that memorizing questions and answers and reproducing certain steps in math problems guarantees a passing grade. The biggest challenge in motivating FMB students for life-long learning is to overcome the students' reluctance to learn more than what is necessary to receive a passing grade in the class. It is possible that FMB educators might not be able to succeed in this endeavor while teaching college courses. They may instead wish to restrict themselves to encouraging statistical (quantitative) thinking which will assist in long-term retention of ideas and FMB course content. An alternative avenue for FMB educators to promote life-long learning is by offering continuing education courses and workshops to young professionals. Often professional foresters realize the importance of FMB after starting their entry-level positions. Creating educational opportunities for university students to mingle with mid-career professionals may be one of the best ways to bring real-world knowledge to the classroom and inspire students to become lifelong learners.

Professional or regional journals and reports are effective vehicles for life-long learning. Therefore, researchers need to ensure that research results move beyond high-impact, peer-reviewed journals to active use by practitioners and managers. This strategy includes making research results more lucid to practitioners and managers, who often have little exposure to statistics and FMB. Researchers and academics should be encouraged to publish their findings in applied journals using professional-friendly language. Some recent examples include Bustos et al. (2010), Edwards et al. (2010), Eskelson et al. (2009), Goerndt et al. (2010), Russell et al. (2010), Vance et al. (2010), Whetten et al. (2010), etc. Unfortunately, research results that do not go beyond the journal fail to contribute to the growth of a profession or make current advances readily available.

2.3. Performance Assessment

Assessing the performance of FMB students is becoming more difficult because the criteria on which we are assessing students are becoming uncertain. For example, should the assessment be based on their ability to carry out the FMB tasks of their first job, on the foundation for their career, or on their critical thinking skills? We must recognize that effective assessment is part of the learning process, not just a judgment of the final product.

To be an effective educational tool, student performance assessments should be reflective of individual development, methodologically diverse, periodic, and relevant to the course learning outcomes and the students' career goals. Contemporary teaching theories maintain that formative assessment should be ongoing and designed to inform students about what they do and do not understand. Cowie and Bell (1999) define formative assessment as the bidirectional process between teacher and student to enhance, recognize and respond to the learning. Modern thinking suggests that any attempt to evaluate the learning outcomes of students must not just include knowledge and skills, but also their personal development (Williams 2006).

Assessment strategies for increased comprehension should be designed to allow the students to demonstrate mastery of the learning outcomes, first indicating the need for students to be informed and aware of the expected outcomes. Performance assessment should occur during learning not at the end of it (e.g., assessing the performance of a student with a final exam only). Traditional assessments examine how much knowledge students can recall and are not structured from the point of view of personal development. Formative assessment allows multiple opportunities for feedback and encourages student self-monitoring and improved understanding of their strengths and weaknesses (Crooks 2001). Effective assessment strategies go beyond examining recollection and regurgitation abilities, to influence the learning behavior of students and promote increased comprehension. With enhanced understanding students can use the newly acquired knowledge or skill to discover relationships and solve new problems. Once students know how they, as individuals, move through the learning process, they are equipped to achieve educational objectives, use outside resources, and become lifelong learners.

In some cases, instructors and students could benefit from student participation in the assessment process. Peer-assessment is particularly important for evaluating joint group or crew work. Students often have skewed views of their own performance, and the instructor may have limited knowledge of the contributions of individual crew members, therefore peer-assessments may be highly valuable for gaining a clear and accurate picture of individual development. Levine et al. (2007) provide an example analysis of student peer reviews and the relationship of these reviews to the results of more traditional evaluation methods, determining that both the assessment vehicle (the questions students respond to) and the frequency and timing of peer evaluations are critical. As in the case of teacher grading, more frequent evaluations during the course may be more useful for the student learning.

In evaluating university instructors and courses, there is a need to allow students to give anonymous and constructive criticism throughout the course, instead of just once at the end of the term. Evaluations can be done online frequently so that teachers and students have opportunities for improvement, consider diverse opinions, and exhibit flexibility in the classroom. Frequent evaluations allow instructors to make necessary changes during the term so that currently-enrolled students can benefit from adjustments.

It would also be effective for students to give feedback directly to instructors early in the term and as the term progresses. Course evaluation should be flexible so that teachers are fully able to utilize student feedback to improve their courses. In addition to being flexible, evaluation forms should vary by discipline and be tailored to the course and students' needs. The comments section of course evaluation form also needs to be flexible so that instructors and administrators can share or discuss suggestions made by the students. Consequently, the current universal course evaluation form may not fit the needs of every course or instructor.

3 Strategies to Meet Challenges

Effective learning requires meaningful, open-ended, challenging problems for the learners to solve (King 2005). In our view, some of the most promising approaches to improve teaching and learning FMB in the 21st Century include: a) Concept mapping; b) Problem-based learning; c) Student-centered approach; d) Experiential learning; and e) Integration of technology.

3.1 Concept Mapping

Concept mapping is graphical depiction of the flow and order of concepts that can be shown as building blocks for a bigger idea or concept. Concept maps represent related ideas and organize knowledge graphically. Details about the theory, methodology, and applications of concept mapping are documented in Novak (1991, 1998, and 2004).

3.2 Problem-based Learning

Today’s employers are looking for graduates that are self-starters. They value communication and problem solving skills very highly, and look for confident employees that can acquire the knowledge and skills to get the job done. Sample et al. (1999) surveyed employers and found a significant gap between what employers wanted with respect to these skills, and what they perceived that students were learning in forestry schools. The employers argued that the demands on forestry professionals are changing and that universities are not meeting the challenges.

The characteristics of problem-based learning (PBL) are: 1) using context-related, real-life situations, 2) focusing on thinking skills (problem solving analysis, decision making, and critical thinking), 3) requiring integration of interdisciplinary knowledge, 4) promoting self-directed learning, and 5) developing life-long learning skills involving sharing and interacting with others in small groups and field settings.

In problem-based learning the students' focus changes from "learning the concepts well enough to prepare for the exam" to "solving real-world problems and being able to demonstrate mastery of the learning outcomes." The learning outcomes drive the assessment, and the assessment drives the learning. The role of the teacher changes from a person who has the knowledge and endeavors to pass it on, to a coach that tutors, advises, motivates and assesses performance.

The challenge to PBL is creating effective problems – it is no easy task. PBL problems are not case studies; instead they are challenging real-world examples requiring students to actively identify aspects of the problem and its solution pathways. Building a problem-based learning environment is essential to enable students to develop generic skills. Applying appropriate statistical principles to solve open ended problems helps students understand that forestry is practiced in non-ideal, poorly defined situations. There is no one right answer. A well trained forester is able to successfully solve these practical problems.

The foundation of problem-based learning is constructivist theory, which argues that people create new knowledge from their experiences. Some real advantages of PBL are that: 1) students are motivated to learn in order to solve an interesting problem, 2) they can clearly see why they need the new knowledge or skill, 3) they must be pro-active and overcome obstacles, and 4) students are able to make connections between concepts and practical applications, and build confidence that they can learn or re-learn as needed to solve real problems. It is important to keep in mind that PBL is not a single education method, but a set of methods based on active learning and solving real-world problems. A single class can use a variety of techniques, some based on PBL and others based on mini-lectures. Teachers can gradually establish to a full PBL course as they become more comfortable with the method and they build up a solid library of problems for the students to work on. Similarly, the courses within an effective curriculum would normally contain a mix of learning methods.

In FMB, there are a large number of applications of fundamental scientific/statistical knowledge that can be transferred into the real-world (e.g., Howard and Temesgen 1997, Temesgen et al. 2006, Younger et al. 2008, Russell et al. 2010). FMB is closely integrated with other disciplines to create innovative approaches. Problem-based learning conforms to the trend of interdisciplinary crossing of contemporary technologies and strategies. A stand exam (timber cruise) is a good example of this multidisciplinarity. PBL techniques could be very effective for students learning FMB, which has creative problem solving at its very heart. See Duch et al. (2001) for a fuller treatment of problem-based learning.

3.3 Student-centered Approach

In the teacher-centered approach, the teacher has the knowledge and endeavors to pass it on to the student. The format is usually oriented towards lectures combined with recitations or labs. Student-centered approaches put more emphasis on the students' activities in learning and teaching. The instructor becomes a guide or coach, stepping in when help is needed, but allowing a high degree of autonomy for students to solve problems through a variety of means. Student-centered approaches can promote thorough processing of knowledge and encourage lifelong learning, because students are engaged in the acquisition of new knowledge and skills more or less on their own. Integrating group projects, such as stand diagnosis, into course design can: 1) allow a more constructivist approach to stimulate profound learning, 2) encourage discussion and cooperation student-to-student, among students, and student-to-faculty, 3) encourage active learning and learning by doing, 4) help to give prompt feedback, and 5) respect diverse talents and ways of learning. These various teaching strategies can be integrated to modify and improve the traditional FMB teaching approaches, in a move from teacher-centered to student-centered learning.

3.4 Experiential Learning

Experiential learning can be any method whereby students learn from their experiences, but in this paper we focus on two aspects of experiential learning: 1) allowing credit for a student's prior experience, and 2) creating a formal program for students to learn through internships and employment, often as part of a formal cooperative-education program. Both of these activities are again driven by having a good set of expected learning outcomes, and having effective methods for allowing students to demonstrate mastery of the learning objectives.

We all know that higher-education students already possess a rich set of prior experiences. In some cases these experiences are accompanied by official transfer credits, which can be evaluated by college professionals – many times, however, they are not. Some schools may allow students to take the exams for a certain class and then either waive the requirement or allow a pass for the course. As learning objectives become more complex, the onus falls on the student to demonstrate mastery of the outcomes. This can be a challenging and time consuming process, but it could be well worth it for mature students who are returning to the classroom after several years in the profession.

Formal experiential learning programs can be an excellent way for students to develop the communication and creative problem solving tools that employers are demanding. It is important to note that formal cooperative-education programs are not just summer jobs. Employers partner with the university to establish a set of learning outcomes for the student placement, and students are expected to demonstrate competency. Often, students are given formal credit for these work placements, and they must produce a report or give a presentation to demonstrate what they learned. Both the employer and the student are evaluated mid-way through the placement to ensure the program is on-track. These formal placements often encompass an academic term to stretch the placement to 6 or 8 months, extending the academic program to five years. The delay in graduation may be an initial barrier for some students; however they may overcome this barrier when they realize that they can earn money and build their résumé while they learn. In many cases the additional motivation gained by being part of a formal coop-education program can encourage students to finish faster than they would have otherwise.

The primary challenge to creating effective experiential learning programs is to connect the work-based learning outcomes to the classroom-based skill development. Secondly, it is important to reinforce the work-based skills when the students return to the classroom. A successful cooperative-education program requires dedicated preparation and continuous improvement to get it right. Otherwise, it can turn into a summer employment program with hit and miss results. Ultimately, the rewards can be well worth the effort, particularly in the areas of communication and creative problem solving.

3.5 Integrating Technology

Technological developments or advances (e.g., internet, light detection and ranging (lidar), and satellite data) can mitigate budgetary pressure via online modules.

Technology-based learning facilitates independent learning and independent thinking, and improves information-retrieval abilities. The online learning environment is an excellent vehicle for lifelong learning and for reaching out to new student populations by allowing "any-time, any-place, any-pace learning" (Johnston 2004). Although we strongly encourage students to get more information from the web, educators must assist students to engage in learning activities, help them to make meaningful connections to prior and new knowledge, identify useful references and monitor their learning progress.

Encouraging students to learn and use geographic information systems (GIS) and lidar by incorporating maps and geo-spatial analysis into class lessons is a promising endeavor. Students can take advantage of the seamless integration of GIS into the curriculum and use this 'new' technology efficiently for other classes and their professional career.

Online learning will become increasingly important in delivering FMB education and training. Online learning is convenient, inexpensive and enables students to seek information, acquire new knowledge, gain feedback on assignments, and communicate with teachers and other students via web sites. To fully benefit from readily available software packages and computing facilities at universities, students need to refine their spreadsheet and database management skills.

Developing effective FMB web learning modules that combine advanced technologies such as lidar and GIS with methodology and pedagogy will enhance student-centered learning strategies and collaboration with industry and land management agencies. Using sophisticated, continuously-updated electronic courses that showcase the most effective and prestigious lectures can contribute to mitigating the budgetary pressures. Thus, using internet modules for teaching forest mensuration and inventory is a viable option.

Technological development mitigates budgetary pressures through the provision of online modules. Harnessing technology for FMB learning makes teaching less costly and more effective. As a result, a paradigm shift is needed in teaching, learning, and providing FMB skills.

4 Integrating Various Approaches in FMB Classes

To illustrate the sophistication and complexity of current FMB teaching and learning strategies in modern forestry practice we consider three examples: concept mapping, capstone project, and the use of online tutorials.**Example 1 – Concept Mapping**

For enhanced long-term learning, lessons and topics in FMB should fit together around a coherent purpose rather than as a collection of interesting lessons or activities that do not achieve a common goal. To meet standards and goals, effective planning keeps the overall goals in sight at each stage of instruction and assessment. The concept map depicted in Figure 1 has effectively been used to illustrate how the forest mensuration course at Oregon State University (OSU) links with other courses and how the FMB tools can be put together.

[Insert Figure 1]

Figure 1. Concept map of principles of forest biometrics/sampling putting FMB tools together.

Example 2 - Capstone Project

This example shows how a group project at the end of a FMB course can be used to 1) combine problem-based learning and a student-centered approach; 2) integrate different skills acquired in the FMB course; 3) enhance the critical thinking skills of the students; and 4) provide the opportunity to the FMB educator to diversify the assessment of student performance.

A project area of (80 to 150 acres) comprised of different forest types is assigned to student groups of four. Students are provided with the location, maps, aerial photos, and GIS layers of the project area. In a simulated work experience, the students are “hired” as consultants and they are asked to design and implement an inventory/stand exam that will yield information on timber volume and value by species or species group (including confidence intervals), timber growth, the number of snags that can serve as wildlife trees, and information on percent cover of understory vegetation layers. Habitat criteria are provided for an endangered wildlife species. The “consultants” are asked to present their estimates of the above forest resources as well as a habitat assessment for the endangered species in a written report and a public hearing. They must also provide a detailed description of their sampling protocol and defend their choices.

While working on the above project, students have to apply skills learned during the FMB course as well as skills acquired in previous courses (e.g., photo interpretation and statistics). Critical thinking is required during the inventory design phase of the project. The students need to decide whether to stratify the project area. They need to choose a sample size for the overall project area and the individual strata as well as plot types and sizes for the different attributes they have to estimate. During the implementation phase of the inventory, the students have to demonstrate the measurement skills acquired during the FMB course. In the last phase of the project, the students show their expertise in the data compilation of their cruise data. Finally, they have the chance to prove their communication skills during a public hearing (e.g., 20 minute presentation per group) and the assembly of a written report. Such presentations and reports at the end of the Forest Mensuration course (5 credits) have been a tradition of the FMB course at OSU. Virginia Tech has a senior capstone course where students are paired with forest landowners to determine their objectives, assess the resources found on the property, and write management recommendations. Mapping and inventory comprise a substantial portion of the assessment component; environmental assessment, economic analysis and other skills learned throughout the four-year curriculum are included. Based on feedback obtained from students and our collective experience, capstone projects have helped students to integrate different skills acquired in the FMB course and enhance their critical thinking skills. The projects have been a great medium to encourage student-centered learning and to diversify the assessment of student performance.

Example 3 – Online Tutorials

Integrating technology and developing online tutorials covering basic prerequisites will help students to get up to speed with their prerequisites. Topics that can be covered in such tutorials include basic geometry (area of a circle, volume of cones, cylinders etc.), and basic statistics (how to calculate means, variances, confidence intervals etc.). Tutorials will aid students to improve their prerequisite knowledge, provide students with practice materials, reduce the need for textbooks to a certain degree, and accommodate students' learning behavior by offering online tutorials with practice problems that can be done at any time, any place, and any pace.

Online tutorials could be used as formative assessment for the students. Short quizzes included in some online tutorials allow students the freedom to test their knowledge without the pressure of an in-class quiz. By utilizing a webpage with problems and solutions for basic math and statistics problems, students can work through these problems to improve their skill set. Students who do not need this review can decide not to do these exercises.

5 Summary and Conclusions

FMB is helping support future forest management practices by equipping students with quantitative thinking and analytical skills, by integrating new teaching strategies to improve students' learning behavior and by improving the delivery of FMB and other quantitative courses. Students benefit from enhanced teaching and delivery methods and gain a more thorough understanding of the specific topical material in FMB classes, while improving communication and critical thinking skills, preparing for professional success, and building a foundation for lifelong learning.

Strategies for meeting the challenges of effectively teaching FMB include a) Concept mapping; b) Problem-based learning; c) Student-centered approach; d) Experiential learning; and e) Integration of technology. Significant challenges exist, such as inadequate student preparation in quantitative and communications skills and lack of student interest in developing skills for long-term learning. To help meet these instructional challenges, assessment methods should be reflective of individual development, methodologically diverse, periodic, and relevant to the course learning outcomes and the students' career goals. We advocate for formative assessment, which focuses on fostering a spirit of creative problem-solving, student self-assessment and development of lifelong learning skills.

An FMB course which uses a case-based learning process to combine problem-based learning with a student-centered approach allows the integration of various skills, enhances critical thinking development, and enables the FMB educator to maximize the benefits of performance assessment. We have effectively used concept mapping, problem-based learning, and student-centered approaches in our FMB courses at OSU and Virginia Polytechnic and State University. Being a lifelong learner is crucial in the context of changing and evolving technology and societal values, and opens doors for numerous possibilities to improve forest management and the delivery of professional forestry services to society.

A highly successful cooperative-education program was developed for the Wood Products Manufacturing program at the University of British Columbia in the late 1990's. The experience from the program has been that students markedly increased their communication and problem solving skills with every work term. Their confidence zoomed, and as a result they were more successful in their academic program than before, and upon graduation they were more successful in attracting employment and building solid careers than those that didn't engage in the coop program. The Oregon State University College of Forestry is currently building a similar cooperative education program for their professional forestry and engineering programs. Time will tell if this program has the same result.

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Acknowledgements

We thank Dr. Ed Jensen and Ms. Kama Luukinen for their insights and comments on an early draft.