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## COMPUTER-AIDED INSTRUCTION IN DENDROLOGY: PREPARATION FOR DISTANCE LEARNING

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**ABSTRACT:** Many state legislatures are increasing public access to higher education by establishing more two-year institutions with lower tuition and fees than four-year institutions. This will likely increase the number of students enrolling in two-year institutions and later transferring to four-year institutions. Transfer students presently comprise more than 30% of the University of Arkansas at Monticello's (UAM) undergraduate forestry majors. These students arrive commonly deficient in six required freshman and sophomore forestry courses and facing four years at UAM to complete their baccalaureate degree. Prospective transfer students need access to freshman- and sophomore-level forestry courses. Forestry majors need tutorials aiding the development of skills and knowledge in plant morphology, identification, nomenclature and silvics. At UAM, dendrology is taught using a combination of computer-based and traditional classroom methods, thereby extending educational experiences to a broader range of learning styles than traditional instruction alone. When combined with distance learning technologies, this approach can potentially reach prospective transfer students. Resolution of course deficiencies reduces problems for transfer students and academic advisors, and homogenizes levels of preparedness leading to higher quality instruction, student understanding and academic success. This paper introduces a series of PC-based tutorials and a format for electronic discussion groups in dendrology intended as part of a package for both resident and distant students. The user-friendly tutorials provide easy access to approximately 120 species of native and exotic woody trees, shrubs and vines of the upper Coastal Plain of the Western Gulf Region. The self examination segment of the software allows students to pretest their skill and knowledge in the morphology, identification, and nomenclature of forest species as part of their preparation for actual examinations. The electronic discussion groups helps students learn from each other while catering to diverse learning styles and study schedules. This approach to dendrology is nontraditional and appeals to students either literate or illiterate in computer usage without reduced participation in traditional classroom experiences.

### INTRODUCTION

Many state legislatures are restructuring higher education and increasing public access by establishing more two-year institutions and reducing charges for tuition and fees at these institutions. For example in Arkansas, there are 30 state-supported two- and four-year institutions (plus other private institutions) serving the higher education needs of approximately three million people. Currently, two-year institutions charge approximate \$30 per semester hour for tuition and fees. This compares to \$65 at four-year institutions. By law, state-supported four-year institutions must accept the transfer credits from the two-year institutions. Thus, two-year institutions are playing an important role in the completion of general education and early major requirements. Careful selection of courses during the first two years of study is especially critical for transfers into highly structured curricula such as forestry. This reduces student trauma and improves academic performance, quality of the graduate and eventual professional success.

The UAM forestry curriculum is highly structured, requiring discipline to complete general education requirements, a core of major requirements, supportive requirements, an eight-week summer camp and 12 hours of free electives for graduation in four years and one summer. Majors normally enroll in six core forestry courses, Introduction to Forestry, Dendrology Laboratory I and II, Silvics, Forest Soils, and Forest Mensuration during the freshman and sophomore years. Dendrology Laboratory I and II, Silvics and Forest Mensuration are prerequisites for summer camp. Summer camp follows the sophomore year and provides field experiences and relevancy for upper-level concepts. All upper-level forestry courses build on these six courses and the summer camp experience. Furthermore, majors may use their 12 hours of free electives as a planned course of study, especially tailored to their individual interests.

### PROBLEM

Transfer students commonly enroll in the UAM forestry curriculum with junior standing but deficient in six, core

freshman- and sophomore-level forestry courses. This scenario often means, first, transfer courses are in excess and/or do not match UAM general education requirements. These courses commonly fill free elective slots, undermining the student's ability to pursue individual interests. Second, the summer camp experience is postponed. Thus, students enter some upper-level courses without the relevancy honed by field experience. Third, in search of a full load, advisors enroll transfers in freshman- through junior-level, general education and professional courses. These circumstances (1) undermine the summer camp experience as a preparatory tool for advanced study, (2) dilute the contribution of free electives to the development of the student's unique interests, (3) contribute to diversely prepared students taking the same course, (4) complicate the delivery of quality classroom information by the instructor plus the synthesis and integration of information by the student and (5) adversely impact the quality of these graduates. At UAM, transfers represent approximately 30% of the total undergraduate forestry enrollment and this proportion is expected to increase.

Many of today's students have access to computer-related technologies at home and in school. These "Nintendo Kids" are often bright, well versed in computer-aided approaches to learning and working and do not necessarily respond to traditional techniques of instruction. Computer technologies as innovative teaching tools potentially provide a creative forum for reaching gifted young minds. As taught in many forestry schools, dendrology addresses aspects of plant morphology, identification, nomenclature, classification and silvics. The presentation of these subjects is well suited to computerization. Thus, the objective of this initiative was to develop computer-aided tutorials in plant morphology, classification, identification and nomenclature for use by resident and distant students in dendrology.

#### MATERIALS AND METHODS

ToolBook<sup>1</sup> 3.0 was loaded on a 155 MHz pentium IBM clone with 32 MB RAM, 2.0 GB hard drive and 32 bit real color video card. Tutorials based on Toolbook were developed in plant morphology plus identification and nomenclature. A dichotomous key and silvics tutorial are in progress. HyperText Markup Language (HTML) was used to develop a set of notes stored on the WWW (address <http://www.uamont.edu>). Undergraduate students developed all tutorials which include professional terms "hotlinked" to a dictionary and graphic images of the feature to be studied. In these learning aids, names follow those of Cronquist (Harlow et al. 1996).

#### Lecture Notes

HTML was used to develop a set of files containing lecture notes covering approximately 120 native and exotic woody trees, shrubs and vines of the upper Coastal Plain in the

Western Gulf Region and introduced in Dendrology Laboratory I and II. Weekly laboratory exercises are stored in separate files containing approximately 15 woody species selected from diverse habitats and forest communities. Students log on the instructor's home page on the WWW and select the lecture notes for the week of study or species desired. Tree size, leaf, twig, fruit/flower, and bark attributes are described for each species (Figure 1). Limited comments about unique properties of each species are also provided. Leaf, twig, fruit/flower and bark are "hotlinked" to color graphic images illustrating the attribute. This tutorial supplements traditional laboratory instruction by allowing students to review trees on sites many miles from campus and print a set of corresponding lecture notes at their convenience.

#### LAB 1- FRONT DOOR OF FORESTRY BUILDING

Species covered include:

green ash, sawtooth oak, weeping willow, eastern redbud, water oak, ginkgo, pecan hickory, cherrybark oak, red mulberry, white ash, common persimmon, eastern redcedar

page

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**green ash**

BRF

**Oleaceae**

**Fraxinus pennsylvanica**

1. small to medium sized tree reaching 50' in height and 20" in dbh
  2. **leaf:** opposite, pinnate, compound, 6" - 10" long; blades, elliptical or lanceolate to ovate - lanceolate; surfaces lustrous green above and below or paler beneath
  3. **bark:** interlacing diamond shaped ridges in the bark; narrow fissures
  4. **twig:** moderately stout with bud sitting on top of a U-shaped leaf scar
  5. **fruit:** dioecious; a samara with slender seed; wings tapering midway along the seed
  6. habitat: bottomland sites
  7. wood sold as white ash; used for baseball bats, tennis racquets, hockey sticks, oars and other play-ground and sports equipment
- etc.

Figure 1. An example of the HTML lecture notes for Dendrology Laboratory I and II. A computer file exists for each of 12 weekly exercises. Each file contains descriptions, complete with "hotwords" in bold type and linked to graphic images of the leaf, bark, twig, and fruit for approximately 15 species.

#### Plant Morphology

Taxonomy requires the development of a professional vocabulary and mastery of the application of these new terms

and concepts for woody plant identification. The characteristics of leaves, twigs and fruits are among the features used during woody plant identification. The objective of this tutorial is to help students learn the types and characteristics of leaves, twigs and fruits including but not limited to (1) leaf arrangements, types, margins, apices, bases, venation, shapes, and surfaces (Figure 2), (2) twigs, their buds and scales, plus lenticels, vascular bundles, spurs, pith, thorns and spines and (3) fruit types of both fleshy and dry simple fruits as well as multiple and aggregate compound fruits. The computer presents leaf, twig and fruit features for comparison and mastery leading to the development of visual recognition skills and vocabulary needed for consistent identification of woody plants.

Identification And Nomenclature

The purpose of this tutorial is to drill students on the identification and nomenclature (including spelling and capitalization) of species of the upper Coastal Plain in the Western Gulf Region. The data base for this tutorial consists of approximately 120 species. A separate game exists for each week, midterm and final laboratory experience. Students select the file for the week or species they wish to study. The computer presents a graphic of a feature (leaf, twig, flower/fruit, habit), a description of the feature and a question: "The Common Name Is?" or "The Scientific Name Is?" (Figure 3). Students read the description for an attribute and study the graphic. If necessary, students click on words "hotlinked" to a dictionary. Furthermore, students may select from other features (leaf, fruit/flower, twig) by clicking on the icon for that feature. After examining the desired feature(s), students enter a reply in the answer box. If the computer detects an error in the answer, editorial symbols are used to help students recognize and correct the mistake (Table 1). The computer allows three attempts, checking each for spelling and capitalization and tabulates a score based on the first attempt, similar to an exam. At the end students are provided a score as if an exam had occurred.



Figure 2. A graphic used to illustrate parts of a simple leaf.

**What is the common name of this tree?**

- leaf
- fruit and flower
- twig
- bark

Scale in inches

**Leaf**

**arrangement:** alternate

**type:** odd-pinnately compound

**margins:** serrate

**shape:** lanceolate - obvate or ovate

**general appearance:**  
7 to 15 often falcate leaflets; rachis, petioles and blades puberulent

Answer

Dictionary

Figure 3. Water hickory (*Carya aquatica* (Michx. f.) Nutt.) as generated by the identification and nomenclature tutorial. Descriptions in bold are linked to a dictionary. Descriptions and graphic images of fruit and flower, twig, or bark are available by clicking on the icon.

Table 1. Editorial symbols used by the identification and nomenclature tutorial to aid students in correcting a misspelled response.

<u>Symbols</u>	<u>Error Explanation</u>
△	Word Missing Here
>	Missing Character After Here
<	Missing Character Before Here
X	Wrong Word
x	Extra Character
=	Wrong Character
~	Transposed Letters

Dichotomous Key

This tutorial illustrates and assists in the development of the vocabulary and logic needed to identify unknown species using a dichotomous key. Development of this tutorial is in progress. The present scope is to include approximately 200 species of the upper Coastal Plain and Western Gulf Region.

The computer presents paired questions (dichotomous key format) with technical terms "hotlinked" to a dictionary. For example, initial questions will be similar to:

- Go to Question
- Are leaves **opposite, simple** and **deciduous** ?
1. Are leaves **unlobed** . . . . . 2
  1. Are leaves **palmately lobed** . . . . . 44  
(Maple graphics)
  2. Are leaves **heart-shaped** . . . . . 67  
(Catalpa graphics)

- 2. Are leaves **ovate, elliptical, lance-shaped, or oval** . . . 3
- 3. **Stipules** or their scars, present . . . . . 4
- 3. **Stipules** or their scars, lacking . . . . . 4  
etc.

Are leaves **opposite, compound** and **deciduous**?

a series of questions here, similar to those above

Are leaves **alternate** , **simple** and **deciduous**?

a series of questions here, similar to those above

By clicking the mouse on bold words (above: opposite, simple, deciduous, ovate, elliptical, stipule, etc.), students read the definition and/or view the graphic image illustrating the technical term. When ready, a click of the mouse returns the student to the original position. Progression through a series of these questions moves the student closer to identifying the unknown species.

Silvics

The purpose of this tutorial is to inform the student of unique ecological, edaphic, hydric, phenological, etc. characteristics fundamental to healthy forests and trees. The computer provides brief essays on each tree species including, but not limited to, a distribution map, site preferences, common associates on these sites, flowering habits, uses, special regeneration characteristics and pest problems. Key words and properties associated with each species will be "hotlinked" to a dictionary. The data base will be the same 120 species as for the previous tutorials above.

Approach and Results

As freshmen, dendrology students are exposed to the information superhighway via the student computer laboratory and the campus network. Students use the computer laboratory for access to the UAM home page (address <http://www.uamont.edu>) in route to the instructor's home page. Users visited the course outline, course assignments and projects, lecture notes and sample exam questions an average of eight times per day during the fall of 1997. Visitors included members of my classes as well as high school students and teachers in the state and alumni from the region.

An e-mail discussion group was established by developing a distribution list of all students in Dendrology Laboratory I. By using the distribution list, questions and replies are circulated to classmates and the instructor. Some students rarely contributing to class discussions were regular e-mail users. Apparently, some students like to investigate their questions prior to seeking help while others prefer to prepare questions in privacy and at their pace. E-mail provides the flexibility needed for both learning styles and the distribution list helps students learn from each other. Students wishing to not use the distribution list may still use conventional e-mail for assistance. Attendance has not suffered as a result of electronic access to course materials and the instructor.

SUMMARY

PC-based tutorials and a format for electronic discussion groups are presented as part of a package for computer-aided instruction in dendrology for both resident and distant students. The user-friendly tutorials provide easy access to approximately 120 species of native and exotic woody trees, shrubs and vines of the upper Coastal Plain of the Western Gulf Region. The self examination segment of the software allows students to pretest their skill and knowledge in the morphology, identification, and nomenclature of forest species as part of their preparation for actual examinations. The electronic discussion groups helps students learn from other students while catering to diverse learning styles and study schedules. This approach to dendrology is nontraditional and appeals to the high-tech appetites of "Nintendo-Kids" and for the computer challenged students, encourages computer literacy early in their collegiate career. After one semester of use, experience suggests computer-aided instruction in dendrology effectively caters to diverse learning styles and study schedules without reduced participation in traditional classroom experiences.

LITERATURE CITED

Harlow, W. M., E. S. Harrar, J. W. Hardin, F. M. White. 1996. Textbook of dendrology. McGraw-Hill, Inc. 8<sup>th</sup> edition. New York, NY. 534pp.

<sup>1</sup> Registered trade mark of Asymetrix Corporation.