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Computer Assisted Instruction Wood Identification Program

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Abstract

In the development of wood identification skills, certain factors are important. These include: mastery of both terminology and technique, repetitive practice experiences, and an individualized approach in both guidance and feedback to the learner. The use of the computer as a programmed instructional aid provides for an individualized approach to learning, simulated teacher-student interaction, and feedback and reinforcement to stimulate learning. The problem of this activity is to develop a computer assisted instructional program to enable the learning of techniques for identifying selected samples of hardwoods.

Computer Assisted Instruction Wood Identification Program

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the Non-Thesis Master of Arts Degree

by
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Introduction

Teaching wood identification as a body of subject matter is based on various needs. Instructors on both the secondary and post secondary levels need to be able to present to their students the knowledge and skills of wood identification. Students in industrial arts and industrial technology require a good foundation in their understanding of materials. A proper understanding of the structure of wood (as an industrial material) will supplement subsequent experiences, such as materials testing and feasible applications in the areas of machineability, finishing, etc. Wood identification skills are also useful to the student as a potential consumer. Its value can be realized in one's ability to evaluate the quality of commercial furniture and residential remodeling or repair work and to select appropriate lumber at the lumber yard. Wood identification, therefore, as an acquired skill can serve diverse needs.

Statement of the Problem

In the development of wood identification skills, certain factors are important. These include: mastery of both terminology and technique, repetitive practice experiences, and an individualized approach in both guidance and feedback to the learner.

The use of the computer as a programmed instructional aid provides for an individualized approach to learning, simulated teacher-student interaction, and feedback and reinforcement to stimulate learning.

The problem of this activity is to develop a computer assisted instructional program to enable the learning of techniques for identifying selected samples of hardwoods.

Definition of Key Terms

Before proceeding further in this report, a definition of terms which will be used throughout this paper is necessary.

Programmed instruction. A type of teaching material utilizing sequential learning experiences, stimulus-response relationships and immediate feedback of results (Espich, Williams, 1967).

Computer assisted instruction (CAI). A type of instruction involving tutorial learning managed by a computer. The language utilized by the Hewlett-Packard computer system for this program is called an author language.

Pretest A. This is a paper and pencil test (using wood set #2) taken by Group B students to assess their level of wood identification skills before beginning the computer program (see Appendix A).

Pretest B. This is a computer file (WIP 0, see Appendix B) which is designed to (a) assess the student's knowledge of wood identification terms, and (b) permit the student to skip already familiar information.

Group A. The first group of thirteen college level students solicited from the Materials Processing Technology course who agreed to take the computer wood identification program.

Group B. The second group of eleven college level students solicited from the Materials Processing Technology course who agreed to take the computer wood identification program.

Ring porous category. A pattern of annual growth rings (found in hardwoods only) in which the springwood cells are large and distinct while the summerwood cells are small and indistinct.

Semi-ring porous category. A pattern of annual growth rings (found in hardwoods only) in which gradation of cell size is observed from springwood to summerwood.

Diffuse porous category. A pattern of annual growth rings (found in hardwoods only) in which there is no noticeable demarcation between springwood and summerwood cells.

Limitations

The following limitations are imposed on this study:

1. Due to time constraints, only twenty-four students were involved in the pilot testing of the program.

2. The students for the pilot testing of the program were volunteers from the Materials Processing Technology course and are not necessarily a representative group of industrial arts/technology students.

3. This study involves only the development of a computer program on wood identification and a beginning analysis of its effectiveness. The nature of the analysis will be non-statistical. Instead it will focus on two items:(a) the affective response of students toward CAI based on a survey of opinions and (b) observations of the program's effectiveness.

Research Methods and Activities

Development of the Program

The present program was developed in a course at the University of Northern Iowa called Programmed Instruction Through Computers (24:205) during the spring semester, 1979. It was extensively revised and expanded during the summer session to basically its present form and length.

The program is designed to be used as support material for college students enrolled in industrial arts or technology courses. At the

University of Northern Iowa in the Department of Industrial Technology, students could be from Production Systems, Industrial Wood Processing, or Material Processing Technology courses, for example. The typical student would be a college junior who has had moderate experience constructing objects of wood at the high school level. However, minimal knowledge of wood technology or skills in identifying wood samples is assumed. The CAI package could be used as a totally independent, self-taught reference by students at the discretion of the respective course instructor.

One objective of this computer program is to enable the student to define and utilize eight key terms (as underlined below) used in wood identification. The student will be able to:

1. define annual growth rings.
2. discriminate between springwood and summerwood.
3. differentiate between sapwood and heartwood.
4. state the three porous categories (ring porous, semi-ring porous and diffuse porous) and discriminate among each type.
5. use the hand lens to analyze wood pore structure.
6. select a sample which illustrates a certain term, given appropriate wood samples and a hand lens.

The primary objective of the computer program, however, is to enable the student to identify twelve species of hardwoods: ash, basswood, birch, butternut, cherry, hickory, mahogany, maple, (red) oak, pecan, poplar, and walnut, as well as state a minimum of two identifying features for each of the twelve species of wood. Stated as specific terminal objectives, the student will be able to:

1. state the color of each respective sample.

2. identify the typical grain configuration of each sample.

3. state to which of three porous groups the sample belongs.

4. choose and identify each of twelve hardwood samples, given thirteen numbered wood samples.

During the program the student has access to appropriate 35mm slides pinpointing key features (see Appendix C), a set of labeled wood samples (Set #1 - see Appendix D), and a hand lens. Satisfactory performance of the student is measured by a score of 75% (9 of 12) or above on a criterion test using thirteen actual wood samples (called Set #2).

Writing of the Program

The writing of the program followed the format of the Instructional Dialogue Facility (IDF) Planning Sheet (see Appendix E for complete derivation). Each of the twenty-one files in the program (see Appendix B) covers a unit of information in corresponding sections. For example, file WIP 0 contains Pretest B and consists of ten questions in as many sections (see Appendix F). (A section is the information contained on one Instructional Dialogue Facility Planning Sheet.)

Pretest B is designed to allow students to skip over already familiar material and start the program at unknown material.

Following the writing of the Pretest B, content was generated on the eight identification terms (WIP 1 and 2), a practice of skills on the ash wood sample (WIP 3), a short practice test on the terms (WIP 4), then a file on each of the twelve hardwood samples (WIP 5 - WIP 19), followed by a posttest (WIP 21). (See Appendix G for the posttest.)

The completed files were organized into a unified program through the flow chart and a selective branching sequence (see Appendix H). This permits students, based on their entry skill level and performance in the program, to take individualized routes through the program.

Testing and Evaluation of the Program

Several students, during the summer session, trial tested the finished program to ensure that the program functioned as designed.

After the trial run, the posttest was revised to improve its usability. The computer program was then ready for pilot testing to ensure that the objectives of the program were being achieved.

With instructors' approval, a brief presentation of the program was made to students in the Materials Processing course with a subsequent request for volunteers. A remuneration of up to six checks or plusses (to be credited to the course grade) was promised students taking the program. Thirteen students comprised Group A while Group B had eleven students. The students were informed by posted notices in the laboratory, as well as personal telephone calls, when and how to take the program. Each student had approximately two weeks to complete the program.

An evaluation questionnaire was developed and made available to each student to be filled out upon the individual's completion of the program. The evaluation consisted of five questions dealing with access directions, program directions, content material, response time and program length. Students were also given opportunity to add additional comments.

The procedure for students to take the computer program was as follows for both groups:

1. Go to the Wagner Resource Center in the Industrial Technology Center.

2. Sign out the Computer Program Training Package from the circulation desk.

3. Obtain the computer access code.

4. Use the Computer Access Directions sheet to log on to the computer program.

5. Do the computer program.

6. Log off the computer correctly.

7. Fill out the Program Evaluation sheet.

8. Return the Computer Training Package to the circulation desk.

After Group A had taken the computer program, minor revisions to the program were initiated based on observation of student performance as well as the information on the Program Evaluation sheets. The following changes were made:

1. Revised CAI Access Directions sheet to eliminate ambiguous information.

2. Revised and added Right/Wrong Answer Groups where necessary to facilitate student progress.

3. Moved hand lens section from WIP 1 to WIP 0 to insure that all students would receive that information.

4. Added clarifying notes and comments as needed throughout the program.

5. Developed Pretest A to assess student wood identification skills before beginning the computer program. (It was felt that students might already know how to identify some of the more common woods prior to taking

the program and that the program wasn't necessarily affecting learning. Pretest A was administered only to Group B.)

Group B was then authorized to take the program. Group B students were given a two week period to complete the program.

Results and Discussion

In Group A, of the eleven students who took the program, five students completed the posttest. In Group B, eight students took the program and seven of those eight completed the posttest (see Table 1).

Table 1

Students Taking Wood ID Program

	Volunteers	No. Taking Program	No. Completing Posttest
Group A	13	11	5
Group B	11	8	7

The posttest scores of Group A ranged from a low of 33% (4 of 12) to a high of 67% (8 of 12), giving an average posttest score of 47% (5.6 of 12).

Table 2

Group A Scores

Student	Posttest Score	Computer Time (Hrs.)
1001	8 (67)[a]	1.5
1004	6 (50)	2.4
1006	5 (42)	2.3
1009	4 (33)	2.2
1012	5 (42)	2.8

Note. Maximum score = 12

[a]Numbers in parentheses indicate percent.

The Pretest A scores of Group B ranged from a low of 8% (1 of 12) to a high of 42% (5 of 12), giving an average pretest score of 25% (3 of 12). The posttest scores of Group B ranged from a low of 58% (7 of 12) to a high of 83% (10 of 12), giving an average posttest score of 69% (8.3 of 12).

By subtracting the Group B average score of 25% from the posttest average score of 69%, one produces a net result of a 44% increase in wood samples identified upon completion of the computer program (see Table 3).

Table 3

Group B Scores

Student	Pretest A	Posttest	Computer Time (Hrs.)
1000	3 (25)[a]	7 (58)[a]	2.0
1001	3 (25)	9 (75)	2.0
1002	3 (25)	9 (75)	2.6
1005	2 (17)	9 (75)	1.6
1006	4 (33)	7 (58)	4.4
1007	1 (8)	10 (83)	2.5
1008	5 (42)	7 (58)	1.7

Note. Maximum score = 12

[a]Numbers in parentheses indicate percent.

A comparison of the posttest scores for Group A (before revision) and Group B (after revision) for each wood sample tested indicates the following results: (a) all wood samples showed a gain except ash which showed a decline of 11.4%, (b) the average increase between the two groups was 22.4%. (See Table 4.)

Table 4

Comparison of Posttest Scores of Groups A and B

	Group A[a]	Group B[b]	Gain/Loss
Ash	40	28.6	-11.4
Hickory	0	57.1	+57.1
Oak	80	100.0	+20.0
Butternut	20	28.6	+8.6
Pecan	40	57.1	+17.1
Walnut	100	100.0	+0.0
Basswood	80	85.7	+5.7
Birch	0	85.7	+85.7
Cherry	0	14.3	+14.3
Mahogany	80	100.0	+20
Maple	40	71.4	+31.4
Poplar	80	100.0	+20

[a]Five students

[b]Seven students

The average time for students completing the program in Group A to take the computer program was 2.24 hours (see Table 2) while the average time for students completing the program in Group B was 2.4 hours (see Table 3).

An analysis of the Student Evaluation forms indicates that the majority of the students had negative attitudes toward the computer program generally for the following reasons:

1. The computer access directions were ambiguous and confusing.

2. The program was too long and contained too much material to assimulate.

3. The computer rate was too fast with not enough appropriate pauses.

4. The computer required rigid answers and correct spelling.

5. The slides and/or wood samples were confusing.

There appeared to be less objections from Group B (after the revision) than from Group A (before the revision). (See Table 5.)

Table 5

Student Evaluation of Program

	Frequency of Response-Group A	Frequency of Response-Group B	Frequency of Response-Group A & B
1. Computer rate too fast - not enough pauses.	3	1	4
2. Slides/wood samples confusing.	2	2	4
3. Difficulty with computer access directions.	5	2	7
4. Computer inflexible (required rigid answers, correct spelling, etc.).	4	0	4
5. Program too long - too much material to assimulate.	3	2	5
6. Programmed Instruction format confusing.	0	1	1

Table 5 (continued)

	Frequency of Response-Group A	Frequency of Response-Group B	Frequency of Response-Group A & B
7. Difficult to use slide carousel.	0	1	1
8. Identification terms confusing.	1	0	1
Totals	18	9	27

Conclusions

From the results cited the following observations are made:

1. Even though there seems to be some learning occurring in students taking the program, the scores of neither group approach the proficiency level of 75% set as a satisfactory criterion test level. The computer program apparently needs further changes to improve the performance level.

2. The revision of the program after Group A appeared to have a positive effect in raising the scores of Group B as well as reducing the level of complaints voiced on the Student Evaluation sheets.

3. Students appeared to be negatively impressed with the computer as a medium to teach wood identification skills.

Recommendations

The following suggestions are offered to improve the program:

1. Several mistakes in program content need to be corrected: (a) In WIP 2, section #5, butternut should be substituted for cherry as an example of a semi-ring porous hardwood. (b) In WIP 8, sections #3 and #4 should state consistently that the pores of hickory are located in the

springwood layer rather than the summerwood layer. (c) A few spelling errors need to be corrected.

2. The computer should be run at a slower rate to allow students more time to read and study the information being presented.

3. The computer program should probably be shortened to eight wood samples by eliminating hickory, pecan, basswood and poplar.

4. The slides and wood samples could be labeled with arrows to identify key features more effectively.

5. The content material on the computer could be transferred to a slide/script or slide/tape format and a comparison test run on the two methods of instruction on a new group of students.

It would appear from the foregoing observations that the computer program needs further revisions and testing on a new (larger) group of students along with sophisticated analysis and assessment to insure accomplishment of the stated objectives of the program.

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Appendix A

Wood ID Pretest

Wood ID Pretest

Time started pretest_____
Time finished pretest_____

Name_____

Date_____

Before beginning the computer program take a few minutes to identify as many of the wood samples (from Set #2) as you can. Do not guess wildly. Name those samples with which you are familiar. Your grade for taking the computer program will not be affected by how well or how poorly you do in this pretest!

No. on Wood Sample	Name of Wood Sample
#1	_____
#2	_____
#3	_____
#4	_____
#5	_____
#6	_____
#7	_____
#8	_____
#9	_____
#10	_____
#11	_____
#12	_____
#13	_____

Appendix B

List of Files

List of Files

Name	No. of Student Responses	Content
WIP	---	Introduction
WIP 0	(10)	Pretest
WIP 1	13	ID Terms
WIP 2	10	Pore Groups
WIP 3	3	Practice ID Skills on Ash Sample
WIP 4	3	Test on Terms
WIP 5	---	Introduction to Enrichment Branch
WIP 6	5	Oak
WIP 7	5	Ash
WIP 8	5	Hickory
WIP 10	5	Walnut
WIP 11	5	Butternut
WIP 12	5	Pecan
WIP 14	5	Mahogany
WIP 15	5	Cherry
WIP 16	5	Birch
WIP 17	5	Maple
WIP 18	5	Basswood
WIP 19	5	Poplar
WIP 21	12	Posttest
WIP 22	---	Conclusion

Note. WIP 9, 13, and 20 are nonexistent files.

Appendix C

List of Slides

List of Slides

10.[a] Cross section of a tree trunk

11. Ring porous category

12. Semi-ring porous category

13. Diffuse porous category

14. White ash (flat sawn)

15. (Red) oak

16. (Red) oak end grain

17. Ash

18. Ash end grain

19. Hickory

20. Hickory end grain

21. Black walnut

22. Black walnut end grain

23. Butternut

24. Butternut end grain

25. Pecan

26. Pecan end grain

27. Mahogany

28. Mahogany end grain

29. Cherry

30. Cherry end grain

31. Birch

32. Birch end grain

33. Maple

[a]Number 10 was chosen as an arbitrary starting number.

List of Slides (continued)

34. Maple end grain
35. Basswood
36. Basswood end grain
37. Poplar
38. Poplar end grain

Appendix D

Wood Samples

Wood Samples

Set #1	Set #2
Ash	Ash
Basswood	Basswood
Birch	Birch
Butternut	Butternut
Cherry	Cherry
Hickory	Hickory
Mahogany	Mahogany
Maple	Maple
(Red) Oak	Red Cedar
Pecan	(Red) Oak
Poplar	Pecan
Walnut	Walnut

Appendix E

Instructional Dialogue Facility Planning Sheet

PROGRAM Section #_____ Options ?:	Instructional Dialogue Facility Planning Sheet Prepared By _____Date_____
Text:	
QUESTION:	
Group #1 Correct Answer:	Group #2
Reply:	Reply:
Wrong Answer: Group #1	Group #2
Reply:	Reply:
Reply to Unexpected Answer:	
Failure Message:	
Hint #1	Hint #2

Appendix F

Pretest B

Pretest B

1. What is the (three word) name given to the layers of new wood formed in the tree each year?

2. Wood which is formed during the spring season (having a band width of cells narrower and lighter in color) is known as _____.

On the other hand, wood which is formed during the summer season (having a band width of cells wider in width and darker in color) is called _____.

3. The inner part (darker-colored wood) of a tree whose cells were dead when the tree was cut is called _____.

The outer part (lighter colored wood) of a tree whose living cells conducted sap is known as _____.

4. A hardwood which has large end grain pores located in the springwood layer but no visible pores in the summerwood layer is called _____ porous.

5. A hardwood which has end grain pores showing gradation from large to small across the entire annual growth ring is called _____ porous.

6. A hardwood which has end grain pores of uniform size spread randomly throughout both springwood and summerwood is called _____ porous.

7. What simple hand-held instrument can be used to examine the end grain structure of hardwoods?

8. Which wood (mahogany or ash) is an example of a ring porous hardwood?

9. Which wood (oak or walnut) has greater variation in color between sapwood and heartwood?

Pretest B (continued)

10. Which wood (hickory or mahogany) has more springwood/summerwood variation?

Appendix G

Posttest

Posttest

1. Which wood is ash? The number of the ash sample is _____.

2. Which wood sample is basswood? The number of the basswood sample is _____.

3. Which sample is birch? The number of the birch sample is _____.

4. Which wood sample is butternut? The number of the butternut sample is _____.

5. Which wood sample is cherry? The number of the cherry sample is _____.

6. Which wood sample is hickory? The number of the hickory sample is _____.

7. Which wood sample is mahogany? The number of the mahogany sample is _____.

8. Which wood sample is maple? The number of the maple sample is _____.

9. Which wood sample is (red) oak? The number of the (red) oak sample is _____.

10. Which wood sample is pecan? The number of the pecan sample is _____.

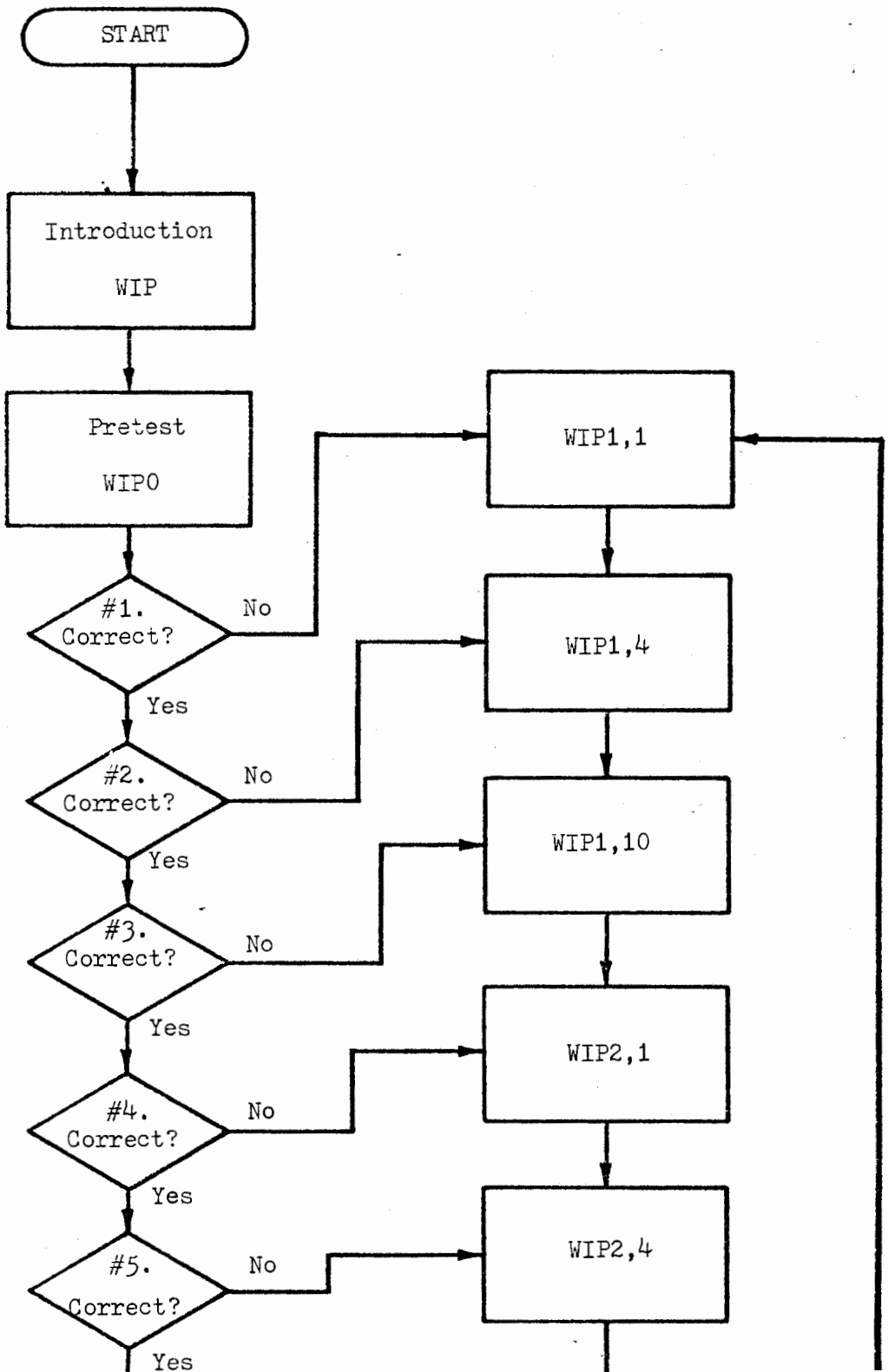
11. Which wood sample is poplar? The number of the poplar sample is _____.

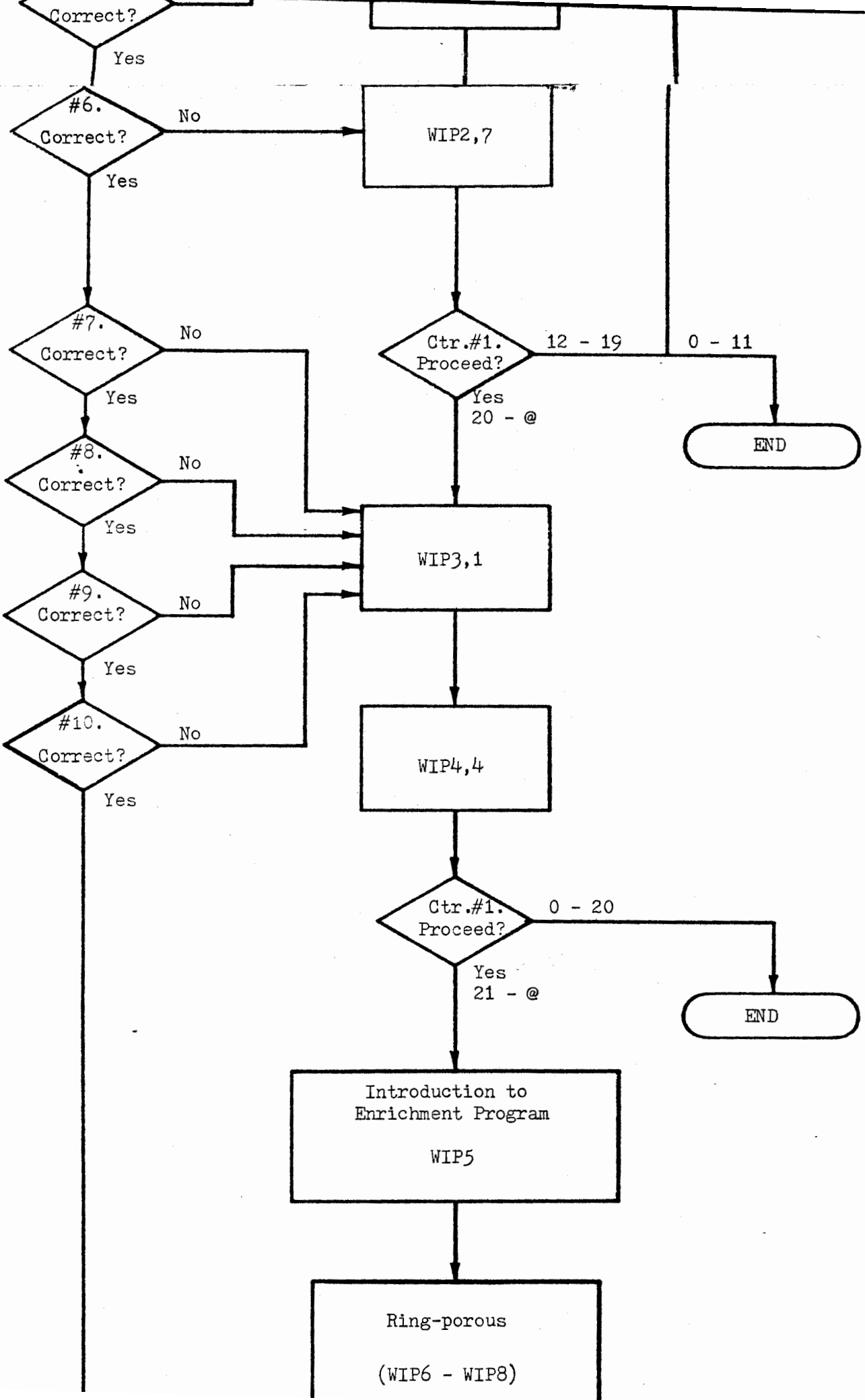
12. Which wood sample is walnut? The number of the walnut sample is _____.

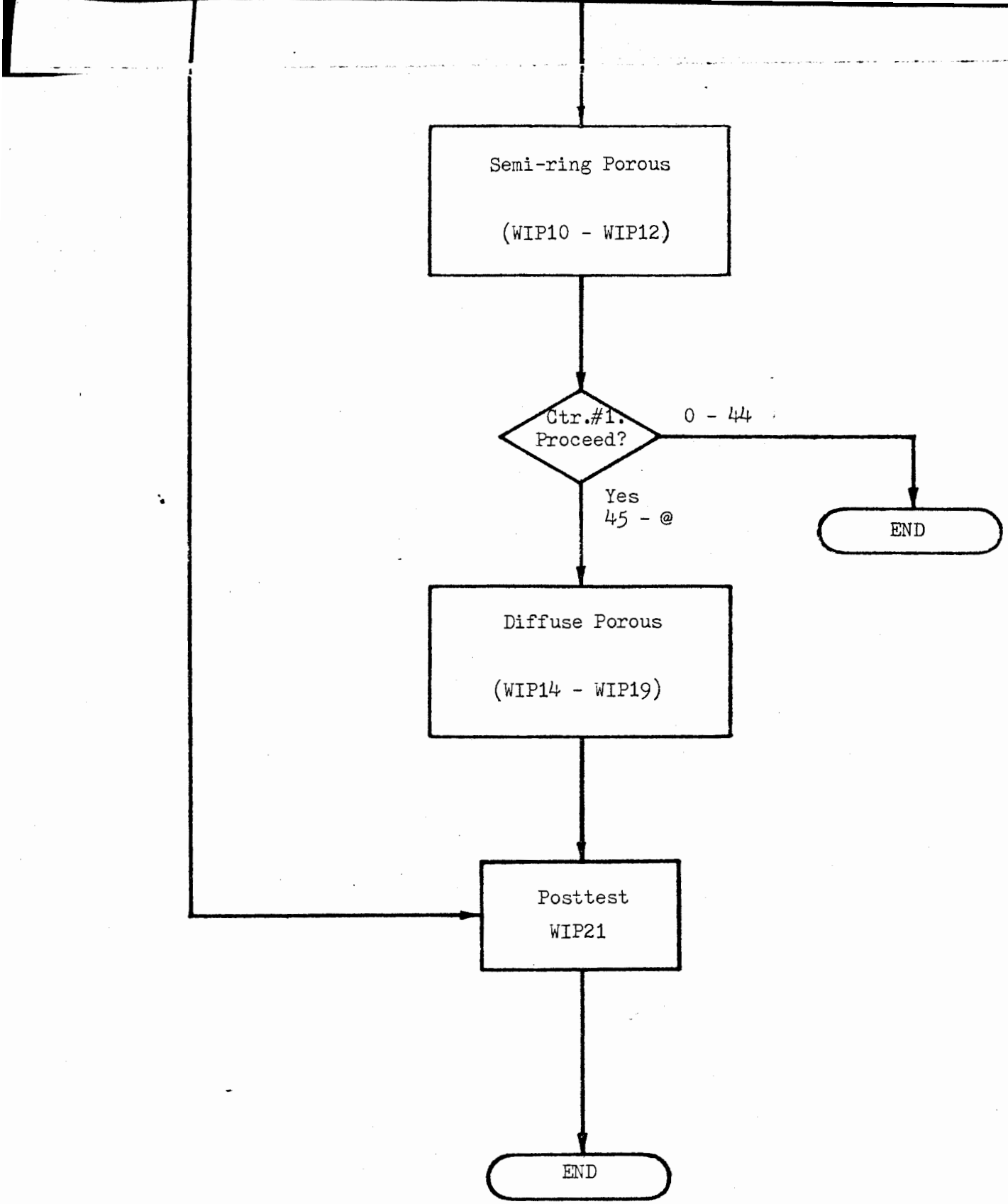
Appendix H

Flowchart - Wood ID Computer Program

FLOWCHART - WOOD ID COMPUTER PROGRAM




Correct?
Yes
#6. Correct?
No
WIP2,7
Yes
#7. Correct?
No
Ctr.#1. Proceed?
12 - 19
0 - 11
Yes
20 - @
END
#8. Correct?
No
Yes
#9. Correct?
No
Yes
WIP3,1
#10. Correct?
No
Yes
WIP4,4
Ctr.#1. Proceed?
0 - 20
Yes
21 - @
END
Introduction to Enrichment Program
WIP5
Ring-porous
(WIP6 - WIP8)


Semi-ring Porous
(WIP10 - WIP12)
Ctr.#1.
Proceed?
0 - 44
Yes
45 - @
END
Diffuse Porous
(WIP14 - WIP19)
Posttest
WIP21
END