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ABSTRACT

The illustrative method of teaching employed in most undergraduate accounting courses is becoming increasingly burdensome to professors and students due to the rapid proliferation of accounting and auditing professional standards and the increased complexity of the tax law. This teaching method may be near the breaking point in upper division courses in the accounting curriculum. Not only does this condition prevent professors and students from reaching teaching or learning goals, it also prevents many capable students from considering accounting as their major or minor curriculum choice. A shift in teaching approach away from examples and toward explicit algorithms would enable the current quantity of material to be maintained with less burden placed on all participants. The algorithmic teaching approach is readily adaptable to accounting courses, particularly when the latter have been broken into specific learning modules. Microcomputers may be used to simplify the teaching and learning process by allowing students to explore complex accounting and taxation algorithms even before the components of the algorithms are fully understood. Discovery learning techniques, in which students derive their own algorithms, are also facilitated by microcomputers. Some examples of an algorithm-based learning module approach in an undergraduate taxation course are provided as well as a list of 14 references. (Author/MES)

TEACHING FOR THE FUTURE WITH ALGORITHMS, LEARNING MODULES, AND MICRO-COMPUTERS--AN ACCOUNTING EXAMPLE

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Most instructors of an upper division undergraduate accounting course will verify that a frequent and earnest student reaction to the course is that too much material was covered in too little time. A common complaint might be that in every class meeting entirely fresh material was presented, leaving little room for repetition and insufficient time for open-ended class discussion. A byproduct of these student perceptions, which becomes shared knowledge, is that many prospective accounting students develop notions that (1) accounting is extremely difficult to master, (2) success depends upon a prodigious ability to memorize, and (3) accounting as a career option should be avoided by all except those who excel in intermediate accounting. These notions are invalid. Accounting is based on a simple, basic equation [Hermanson, et al., 1986, p. 20]; although, admittedly, certain components are difficult to define. Success will depend upon an ability to discover reusable principles from examples and an ability to recognize the substance of transactions--not memorization of rules for every possible situation.

Part of the difficulty in teaching accounting is due to the traditional teaching method used--the illustrative method [Ijiri, 1983, p. 169]. In this method, adopted by most textbooks and followed by many instructors, complete examples are presented to the student, the student induces underlying rules from the examples, and then the student works out solutions to assigned problem materials. This is an effective method of teaching, but it often leaves the student unable to communicate nearly as well in the abstract (in spite of the rules induced) as with additional examples [Ijiri, 1983, p. 170].

This teaching method may be at or near the breaking point in effectiveness in courses such as intermediate accounting, cost accounting, and individual income taxes, because too many examples must be assimilated before a student is able to obtain the breadth and depth of understanding that we typically aim for. For instance, West's Federal Taxation: Individual Income Taxes [Hoffman & Willis, 1984] contains 727 numbered examples within its 20 chapters, most of which would be covered in a typical one semester course. In addition, following each chapter is a large number of questions and problems (typically, more than 50) which further illustrate the chapter contents. Only those students who are able to formulate abstract rules are not overwhelmed by the numerous examples.

Fortunately there is some potential relief for students (and instructors) in the pedagogical process for accounting. It would take the form of a major change in the way material is presented and it could, as a byproduct, enable a much more thorough integration of computers into the learning process. This relief is possible with a basic change in emphasis away from the illustrative method and toward algorithm-based learning modules.

Accounting Algorithms

Algorithms have been implicitly used by accounting instructors for quite some time. This has been through the illustrative (problem-solving) approach. When the student is able to identify, inductively, the algorithm demonstrated through the problem material, additional problems may be solved with relative ease [Umapathy, 1984, p. 137]. Making the algorithm explicit, whether in the form of a decision-tree, flowchart, formulated worksheet, or computer program, should give the student a breakthrough without necessarily reducing the quantity of topics covered or the depth of the coverage. Umapathy (1984, p. 137) suggests students can learn to use an algorithm with negligible external assistance if check figures for critical steps in solving a problem are also provided.

An example of a simple algorithm in statement form follows. It is based upon the special deduction available to working couples to alleviate the "marriage penalty." The special deduction is 10% of the lesser of (a) $30,000 or (b) the qualified earned income of the spouse with the least earned income [IRC Sec. 221 (a)(1)]. A typical example that could be solved with this algorithm would be to compute the special deduction for a married couple, H and W, having earned income of $18,000 and $22,000, respectively. Their working couple deduction would be $1,800 (10% of $18,000). If their salaries were $48,000 and $52,000, respectively, their working couple deduction would be $3,000 (10% of $30,000). This particular algorithm is quite simple and presenting it to students in the form used above in reading material or in a class lecture should be sufficient coverage without further illustration.

Teaching with explicit algorithms may take two forms: reception learning of generalized algorithms and computer-assisted discovery learning of accounting algorithms [Bentz, 1974, p. 215]. Bentz [1974, p. 216] cautions that with the reception learning method, where algorithms are presented in a general form and then applied to a series of problems, (1) students are not required to think about the algorithm, (2) students may wind up with only a preverbal understanding of the algorithm, and (3) students may not be as motivated as they would be if challenged with a puzzle to solve. Discovery learning of accounting algorithms, however, has as its goal the construction of an algorithm to solve problems of the type being studied [Bentz, 1974, p. 217]. The algorithm may be specified in many forms, including computer programs. Bentz [1974, p. 217] argues that some of the benefits of the latter form, from an instructional standpoint, are (1) better motivation due to feedback in the algorithm construction stage, (2) inherent satisfaction in the task itself, and (3) better understanding of the accounting procedure due to the higher level of abstraction necessary to produce the algorithm. An example of the algorithmic approach for the individual income taxes course follows.

Table I is a list of many of the algorithms presented in a typical one semester course in individual income taxes. This list approximates what instructors would cover in such a course. As in all matters of curriculum content, there exist differences of opinion and, perhaps, this list would not be regarded as completely acceptable by everyone. Also, certain of the listed items really cover a set of related algorithms as opposed to a single algorithm. Income averaging, for instance, includes two different methods. The major instructional question in teaching individual income taxes using an algorithm-based approach concerns whether to employ the reception learning method or the discovery learning method (with or without computer assistance). Many of the algorithms are simple enough to require only the reception learning method. Refer back to the working couple deduction example. Mere presentation of the algorithm should provide students with the highest level of abstraction, precluding further effort. The same should hold true for many other algorithms on the list: self-employment tax, group-term life insurance inclusion, investment interest, and capital loss deduction, for example. In general, the more complex the algorithm, the greater the benefit of using the discovery learning technique. As a practical matter, time is a constraint to the use of the discovery method since the student will have to formulate the algorithm--a potentially time-consuming process.

Learning Modules

For a conventional university course held over a fixed time period, such as one semester, the course may be broken down into modules. These modules consist of: a title, behavioral objectives, tests of absolute performance,

TABLE 1

Partial List of Tax Algorithms for Individual Income Taxes

A. Taxes and Credits

1. General individual tax formula
2. Self-employment tax
3. Income averaging (5 yr. and 10 yr.)
4. Alternative minimum tax
5. Investment tax credit
6. Earned income credit
7. Child and dependent care credit
8. Tax credit for the elderly

B. Gross Income Inclusions, Exclusions, and Nature

1. Netting process for property gains and losses
2. Annuity income exclusion
3. Group-term life insurance inclusion
4. Unemployment benefit inclusion
5. Installment sales income
6. Vacation home rentals
7. Recapture as ordinary income (Sec. 1245, etc.)
8. Gains from subdivision of realty by a nondealer
9. Postponed gains (Sec. 1031, etc.)
10. Alimony inclusion and exclusion

C. Deductions

1. Moving expense
2. Investment interest
3. Charitable contribution amounts (ordinary income property, capital gain property)
4. Charitable contributions limitations (50%, etc.)
5. Medical expense
6. Casualty and theft losses
7. Auto expenses for business transportation
8. Entertainment facility dues
9. Long-term capital gain deduction
10. Capital loss deduction
11. Working couple deduction

D. Special Deductions for Businesses

1. Cumulative adjustment for accounting changes
2. Bad debt expense (reserve method)
3. Cost of sales under dollar-value LIFO
4. ACRS
5. Depreciation, depletion, amortization
6. Compensation limits under qualified pension and profit sharing

and instructional method alternatives and resources [Bourque, 1974, p. 263]. Table 2 is a possible set of modules for an individual income taxes course.

Table 2

Modules for Individual Income Taxes

		Weeks
A.	Introduction to Taxation	1
B.	Tax Computations	1
C.	Gross Income	2
D.	Personal Deductions	2
E.	Employee Expenses	1
F.	Business Income and Deductions	3
G.	Property Gains and Losses	3
H.	Tax Credits	1
	Subtotal	14
	Testing	1
	Total	15

Table 2 is arranged for a fifteen week course, which incudes one week for testing. For each module, the instructor should develop an outline which includes the topics and their interrelationships. This outline will include all of the relevant tax algorithms. For instance, Module C, Table 2 (Gross Income) might include all of the algorithms from set B (Gross Income Inclusions, Exclusions, and Nature) except, perhaps, items 1, 7, 8, and 9. The latter might be more conveniently covered in Module G (Property Gains and Losses). The order in which the modules are listed in Table 2 is also not definitive. Many instructors would change it to suit their needs.

Integration of Computers into Individual Accounting Courses

Injiri [1983, p. 168] predicts that "by the end of the 1980s, personal computers the size of a standard textbook will be as popular in classrooms as calculators are now." Perhaps in recognition of this trend, the AACSB, in their interpretations of standards for accounting programs, states that students are expected to use the computer in accounting courses (AACSB, p. 44).

There is substantial research support for integrating computer applications into accounting courses. Stone [1974, p. 29] lists the following categories into which computers may be used in accounting education:

1. canned programs;
2. computerized cases and practice sets;
3. games and simulated environments;
4. computer aided instruction;
5. data-based systems; and
6. student-developed programs.

Canned programs enable the student to solve data-rich problems without extensive background in programming or, for that matter, of the analytical techniques necessary for solving the problem. An obvious situation in an accounting course where a canned program might be used is to solve a comprehensive tax return problem. Outslay, et al. [1983, pp. 431] suggest a framework for such problems. These problems may be introduced early in the course (even used with the introduction module) if they are not too complex. Subsequent examples may be designed for use following each module to reinforce the particular material from the module.

Computerized cases and practice sets are special purpose canned programs, specifically related to problem materials in hard copy [Stone, 1974, p. 292]. Most of the textbook publishers offering accounting texts either currently have or plan to publish student workbooks, supplementing their texts, which provide computer problems and cases.

Business games have been widely used with computer simulations in management courses. In the accounting curriculum, these techniques could be readily adapted to tax planning cases in individual income taxes. This is also, incidentally, the area in which many instructors skimp, since they are under continuous time pressure to cover voluminous sets of examples related to tax compliance. Tax planning exercises with a computer might provide the challenge that some students find missing in individual income taxes.

Computer-aided instruction and data-based systems probably are inapplicable to this discussion since the emphasis has been on upper division study in a classroom setting. However, it should be noted that computer-aided instructional techniques, which have been experimented with widely for elementary accounting courses, may be applicable to those upper division courses which contain a large number of short steps or procedures which the student should be led through.

Student-developed programs are a natural choice in any course where discovery learning of accounting algorithms is specified. For instance, an instructor in a tax course might assign his students the task of writing a program to show the maximum annual writeoff in each year of the life of a new piece of five-year ACRS property, acquired in 1985, to include each of the following: availability or not of the Sec. 179 expense, use of statutory percentage or straight line method, use of extended life options with the straight line method and use of the maximum or reduced investment tax credit.

Recent research in the use of computers in accounting education has tended to suggest positive benefits from existing computer applications. Friedman [1981, p. 142] found significantly higher scores in the AICPA Achievement Test (Level II) for students in an intermediate accounting test group which used the computer as a problem solving tool as opposed to the control group taught in the conventional manner. Groomer [1981, p. 940] asserted that evidence from three experiments suggested strongly that introductory students using PLATO (Programmed Logic for Automatic Teaching Operations) performed better than those who used a human tutor.

The Committee on the Role of the Computer in Accounting Education [1970, p. 37] recommended that it is both desirable and feasible to blend the computer into the portions of accounting education relating to analytical techniques and problem solving. Thomas [1984, p. 32] found that as of the

Spring of 1983, 31% of the AACSB schools responding to his survey, were using microcomputers in teaching accounting and that this would soon rise to 48%. Duangploy and Melcher [1984, p. 34] found that the extent of current and future hands-on computer applications in undergraduate courses was 10% and 39%, representing student usage of one to ten hours per week.

<u>Summary</u>

Two alternatives available to accounting instructors who are squeezed for time in a one semester course are (1) to continue to use the illustrative method of learning with a reduced course content or (2) to adopt algorithm-based learning modules and maintain the existing content. An added benefit of the algorithm-based learning method may be the ease with which it will enable the utilization of computers into the curriculum. The selection of the learning modules and the relevant algorithms may still be individually fitted to the particular instructor and student group. Presently available textbooks are readily adaptable to this design. Finally, algorithms may be introduced into the individual income taxes course directly (reception learning) or indirectly (discovery learning). In each method an explicit algorithm is studied and the student's level of knowledge should reach a desirable level of abstraction. Such knowledge should be both easier to retain and to use than memorized examples.

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