Economic Instruction

In this section, the *Journal of Economic Education* publishes articles, notes, and communications describing innovations in pedagogy, hardware, materials, and methods for treating traditional subject matter. Issues involving the way economics is taught are emphasized.

MICHAEL WATTS, Section Editor

A Characteristics Approach to the Evaluation of Economics Software Packages

Keith Lumsden and Alex Scott

The problems associated with conducting large-scale research projects to assess the efficacy of teaching techniques in economics are well known. In the United Kingdom, we have found that these problems are compounded when attempting to evaluate the contribution that computers make to economics learning. As a result, despite the much wider use of computers in economics teaching in the United Kingdom than in the United States, no hard empirical data exist in the United Kingdom on the contribution of computers to economic education, and there appears little likelihood of such data appearing in the immediate future. Nevertheless, casual empiricism and the widespread adoption of software teaching packages suggest a vital role for the computer in economic education. By observing the uses to which the computer has been put and the characteristics of the programs adopted, we have identified areas in which the computer may have an absolute advantage over conventional teaching techniques.

The two main areas where the computer has significant potential in economic education are simulations and data handling. Many other appli-

Keith G. Lumsden is a professor and director at The Esmée Fairbairn Research Centre, Heriot-Watt University, Edinburgh. Alex Scott is a senior research fellow at The Esmée Fairbairn Research Centre. *The authors wish to thank Kalman Goldberg, who, in his editorial capacity, is largely responsible for the form and focus of this article.*

cations exist, including computerizing textbooks and multiple-choice-question banks, transferring graphical presentations to the computer screen, and tracking students. Although it is readily understandable why computer aficionados develop such programs—they are relatively straightforward to produce—expenditure on these developments is difficult to justify on pedagogical grounds. They seem to have no advantage over conventional techniques and merely give the appearance of moving economics into the high-tech age.

Ease of programming may explain not only the plethora of simple programs available today but also the low adoption rate of such programs. Important learning and teaching characteristics are missing from most of these programs. The following discussion focuses on the pedagogical characteristics that relate to successful teaching techniques of any type, whether computer related or not. These are grouped into three categories: (1) the Bloomian taxonomy, guidelines of types and levels of learning to be achieved; (2) characteristics of teaching techniques that arouse student interest and, thereby, stimulate learning; and (3) approaches that are most appealing to teachers and, therefore, are most likely to be adopted and used. The compatibility of these characteristics to computer use is then examined with specific reference to the most widely adopted economics software package in the United Kingdom.

The issue facing an economics teacher is to find the most cost-effective collection of pedagogies to present to a heterogeneous economics class, given time and budget constraints and his or her own preferences and goals. The issue facing a student is which pedagogies should be deployed to maximize educational objectives, given his or her characteristics, constraints and preferences, and imperfect knowledge of the measuring instrument of economics comprehension, that is, the final examination.

PEDAGOGICAL CHARACTERISTICS

The Bloomian Taxonomy

Bloom's taxonomy can be used to classify the learning hierarchy into various categories: knowledge, understanding, application, analysis, synthesis, and evaluation. Most beginning economics courses attempt to achieve these learning objectives, albeit with varying weights, but because analysis, synthesis, and evaluation are the most difficult to teach and because conventional teaching techniques are least suitable for these higher-level learning objectives, they tend to be underemphasized in many introductory courses (Case and Fair 1985).

Student Interest

In a beginning economics course, various pedagogical characteristics appeal to students. The following list is not exhaustive; nor is it completely

subjective, being based on large-scale empirical studies of student opinion (Lumsden 1974; Lumsden and Scott 1983).

Relevance to real life. Many introductory economics courses in the United States underwent drastic revision during the stormy 1960s. Students wanted courses to be related to what they saw as pressing economic and social issues. In many courses, the time spent on theory was reduced (this reduction was aided by the introduction of programmed learning textbooks), and the allocation of time to cases and real-world examples increased. This changing emphasis was reflected in increased production and use in the classroom of casebooks and books of readings.

Fast feedback. Although students have different goals in courses—for example, maximizing a grade versus getting a safe pass—they share a need for information on learning progress that will help them to allocate their study time efficiently. But some courses do not provide the fast feedback many students seek. For example, instructors may delay in grading required essays. And then, when they do finish grading the essays, they place them in the students' mailboxes, where many will lie untouched until the students clean out their boxes at the end of the term. In contrast to such delayed feedback, the fast feedback provided to students by programs such as TIPS (Kelley 1968) removes uncertainty about progress, permits remedial action to be taken promptly, and explains the popularity of TIPS among students.

Teamwork. One of the advantages of the teaching assistant (TA) system in the United States is that graduate students learn basic economics by being forced to interact with undergraduates. In many business schools, a major pedagogical approach is the process of helping people learn to work together, as preparation for becoming successful managers; an example is group preparation of cases and their presentation in class. For a variety of reasons, the typical introductory course does not provide much scope for peer-group interaction, even though such interaction could have the high peer-learning payoff found in business schools.

Hypothesis testing. Sophisticated hypothesis testing lies in the domain of the economics Ph.D. student. Because conventional teaching methods allow only limited scope for this exercise, they fail to give students the opportunity to test theories using real or simulated data and, consequently, the opportunity to reinforce their understanding of economic concepts and ideas.

Learning by doing. Students do not learn well by hearing or seeing; they learn by doing. Despite the fact that most teachers accept this premise, established teaching practices rarely provide opportunities for learning by doing. Cynics (realists?) argue that teaching practices reflect the interests of the teacher, not the well-being of students. Although such techniques as using programmed textbooks, self-test multiple-choice questions, and cases involve doing—and are generally acknowledged to have a significant impact on learning—the learning skills involved are at the lower end of the Bloomian taxonomy.

Comparison of performances. Although the goal of many students in courses is to achieve a safe pass, the element of competition is also impor-

tant to many students in academic and social life. The organization of classes and schools into teams and houses that compete in sports and in academic subjects is a dominant feature in U.K. high schools and is designed to increase student effort and performance.

Directed learning. The advantage claimed for small class size is that the teacher becomes familiar with each student's progress and is thus able to direct each student individually. Because individualized instruction is impossible in large classes, the emphasis in most types of computer-assisted learning is to provide students with remedial assignments for areas imperfectly understood and to specify relevant reading or textual material. Isolating individual students' areas of weakness and assigning remedial materials permit efficient use of study time by each student.

Portability. A substantial part of learning occurs outside the classroom. Textbooks and workbooks have the advantage of being portable, which allows students to study in the library, on the lawn, or at home. When computers with larger memories appear in more homes, advanced learning will be possible outside universities.

Enjoyment. A large survey involving 3,000 Economics I students was carried out in 1979–80 in nineteen U.K. universities and polytechnics. The students were asked how much they liked different teaching techniques, irrespective of the techniques' contribution to learning (Lumsden and Scott 1983). Lectures and TIPS topped the ranking, with cases proving to be least popular. Unfortunately, no computer-associated techniques, other than TIPS, were involved in this study.

If students are more motivated to study and learn when they enjoy a course, it follows that the popularity of a pedagogy should be a factor influencing its adoption. Despite the lack of empirical evidence on the learning effectiveness of different pedagogies in relation to their popularity with students, the choice of popular pedagogies suggests that student enjoyment does enter the decision-making process in universities and colleges; for example, the choice of Economics I lecturers is not a random process in most institutions.

Teacher Interest

The fact that certain pedagogical features appeal to students is no guarantee that a particular technique will be attractive to the teacher; indeed, some techniques that are highly appealing to students are unacceptable to teachers because of the demands they make on teaching time.

Cost of pedagogy. A teacher will consider certain costs of a new pedagogy and may be constrained by who bears these costs:

1. Departmental costs. A departmental budget constraint may prohibit the adoption of certain techniques, such as videotapes and computer programs.
2. Student costs. Many teachers in beginning economics courses feel constrained by price in their choice of recommended textbooks and workbooks.

Thus, in the larger undergraduate courses, a single recommended textbook is not unusual. This is in contrast to graduate and upper-division undergraduate courses where a large selection of textbooks is recommended; here, the cost tends to be borne by the university library, and this solution is feasible given the typical small class size.

3. Teacher costs. The lack of adequate incentives for teachers to allocate more of their time and resources to teaching is well known. Anecdotes abound about ancient lecture notes, antiquated cases, and real-world examples from the distant past. Publishers and authors of new editions of major textbooks have to preserve an equilibrium between being up to date and minimizing content change so that the teacher can adopt the latest edition comfortable in the knowledge that existing lecture notes will mesh with this edition.

The personal setup costs of a new technique—how much time has to be invested in mastering it and the expected payoffs from using the new technique—will figure importantly in teachers' decisions to adopt the technique.

Significant part of the course. If a new pedagogy involves substantial start-up costs to the department or the teacher but involves only a small part of the course, it is unlikely to be adopted because it will not be considered cost effective. Myron Joseph's Wheat Game (Joseph 1965) is an example of an effective technique for showing how prices are determined in a competitive market; it covers a small part of the course but has minimal preparation costs and thus is cost effective. TIPS, on the other hand, involves substantial setup costs (not the least of which is the detailed course management plan), but because it embraces the entire course it also is cost effective.

Intellectual springboard. Any technique that assists in efficiently moving up the Bloomian hierarchy of learning can be of considerable value to the teacher. For example, it is much easier to lecture about the potential impact of current changes in fiscal and monetary policy on a real economy if students have run a simulation model of that economy and have analyzed the impact of their policy changes in a hypothetical situation. Similarly, discussing quite complex empirical studies is much easier if students have struggled with simple data-handling problems using elementary statistical packages.

Adding a dimension. There are some areas of economics that are almost impossible to teach by lecture and discussion—for example, dynamic interdependence. Students can grasp the simple Keynesian multiplier process as laid out in the basic textbooks; this becomes more complex as the accelerator process is added, and it becomes extremely complex when international leakages are added together with a negative monetary-impact multiplier and a positive expectations multiplier. When teachers further explain that these multiplier values also depend upon the current unemployment rate and are affected by lags in the economy, which is, in turn, subject to exogenous shocks, students' eyes glaze over.

User friendly. A consideration relevant to any teaching technique, particularly one involving computers, is its ease of use for both teacher and student. If instructions are ambiguous, if programs require the continuous attendance of a computer operator, and if programs regularly crash, adoption will be short-lived. Thus, techniques involving computers require extensive and expensive field testing to eliminate bugs; they also require detailed documentation and instructions.

RUNNING THE BRITISH ECONOMY

Running the British Economy (RBE) (Lumsden and Scott 1981, 1982, 1983, 1984, and 1987) was designed to incorporate those features of the computer that can respond to the student-interest, teacher-interest, and higher-learning characteristics of the Bloomian taxonomy. This section describes and evaluates RBE in that context.

Although RBE has been implemented successfully in U.K. high school economics courses (which are equivalent to many U.S. undergraduate courses), the lack of computer laboratories for large numbers of students and the time requirement have slowed its implementation in U.K. universities (despite its acknowledged relevance). University timetabling does not easily permit large blocks of uncommitted class time within which to run RBE.

RBE is used worldwide in business executive courses. In these courses, sufficient scheduling flexibility exists to run RBE as desired. Course evaluations are subjective, but the macroeconomics course incorporating RBE is rated at least as high as accounting, finance, marketing, and organizational behavior by a highly critical audience paying hard cash for its education. RBE has been used for the past four years in an annual four-week course for executives in shipping and related industries. Participants, limited to approximately twenty-five each year, completed a questionnaire on all aspects of the course. Their evaluations ($N = 97$) of RBE were as follows: *excellent*: 79 percent; *good*: 20 percent; *fair*: 1 percent; and *poor*: 0 percent.

RBE is the most successful program pioneered in the United Kingdom (Hurd 1986), and it is widely used in U.K. high schools, universities, polytechnics, and business schools. It also features prominently in business executive programs throughout the world. A version developed for the United States (Lumsden and Scott 1986) currently is used in executive programs in the Stanford Business School and in a number of major companies. An Australian version (McKenna, Lumsden, and Scott 1985, 1986) has been widely adopted in high schools in Australia.

In RBE, students are presented with an eight-year history of a hypothetical economy resembling that of the United Kingdom. They can observe the fiscal and monetary policies adopted in the eight-year history and attempt to assess their impact on the economy. This puts students in the same situation as economic policy makers: they have some relevant historical data and some understanding of macroeconomic concepts. Teams of four students then assume control of fiscal (G, TAX RATE, and VAT

RATE) and monetary (M) policies and run the economy for a ten-year period. The objective is to maximize total "welfare" points for the period; these points are generated annually by a welfare function. Four individuals is the optimal team size; this number has been found to be small enough to enable consensus to be reached speedily and not too large to discourage participation by an individual.

The process of making ten sets of decisions and analyzing results after each decision takes about three hours; this time requirement has implications for the way in which RBE is integrated into the teaching schedule. RBE can be run with or without annual exogenous shocks; the latter method normally is used to explore the characteristics of the model, whereas the former method provides the opportunity to run the economy in a real-world environment.

RBE's success can be explained partly by how it measures up to the pedagogical characteristics discussed above. It has been apparent that RBE is not highly rated according to all characteristics, despite its success. This suggests that there are trade-offs between characteristics and that some characteristics are more important than others. These issues are discussed next.

RBE and the Bloomian Taxonomy

RBE is successful in meeting most of the higher-level learning objectives of the Bloomian taxonomy:

Knowledge. After running RBE, students are better able to recognize economic indicators and to understand what they mean in relation to the economy. This becomes apparent as students start to discuss movements in indicators such as the unemployment and inflation rates, the exchange rate, and international monetary flows.

Understanding. As students continue to run the simulation, their understanding of interrelationships and how the economy as a whole responds to stimuli is greatly enhanced.

Application. RBE, a complex exercise, does not lend itself to simple applications. A successful run requires understanding of complex ideas and their interaction and applying what has been learned from each year's inputs and outputs.

Analysis. The ability to analyze problems is crucial to running RBE successfully. For example, identifying the possible relationship between the unemployment rate and the inflation rate, and how the two relate over time, requires the exercise of analytical abilities. The existence of a strong expectations effect in RBE means that it is possible to generate stagflation in one year and subsequently produce a year in which the economy is at full employment with a zero inflation rate; students are thus given a unique opportunity to analyze the implications of a shifting Phillips curve.

Synthesis. Conventional macroeconomics instruction often treats fiscal and monetary policy separately. RBE demonstrates that the two are closely

interlinked and helps students to achieve an overview of how the system operates.

Evaluation. Without explicit criteria, it is impossible to determine whether one economic state is preferable to another. The concept of trade-offs is captured by the welfare function, and students learn that macroeconomic policy making has no direction unless there is a set of specified objectives with trade-offs among them. Also, because the success of any one year's policy decisions is a function of the existing state of the economy at the beginning of that year, students constantly have to evaluate the current state of the economy and underlying trends. For example, if past policies have produced a situation in which next year's exports will increase rapidly and imports will be sharply curtailed (e.g., domestic deflation coupled with foreign inflation, rapidly rising foreign GNP, and devaluation of the currency) and the situation is not recognized, excess demand could result, with a consequent loss of welfare points. In addition, this situation could cause future stabilization problems in the absence of remedial action.

RBE and Student Interest

RBE also has many characteristics that capture and hold student interest:

Relevance to real life. There is a clear connection between what monetary and fiscal authorities do and the decisions made by teams running the simulation. Experiencing inadequate information, partial understanding, uncertainty as to the outcome of policy decisions, and the complication of exogenous shocks brings home the problems of economic policy making.

Fast feedback. The economic data are produced as soon as the policies are entered into the computer. Because the output is available immediately, there is continuity between the process of decision making and subsequent outcomes.

Team interaction. Many educators have stated that the interaction among team members transcends anything they have witnessed in education.

Hypothesis testing. The teams start with the history of the hypothetical economy. On the basis of this history, they make their first decision; the resulting output is the test of their initial hypothesis, which they keep amending as the run progresses.

Learning by doing. Teams learn their lessons the hard way, that is, by having to live with the consequences of their decisions. There is a great deal of active participation by team members in analyzing data, suggesting hypotheses, and interpreting the outcomes for each year.

Comparison of performances. The welfare function is an important component of RBE; if there is no explicit welfare function, the assessment of macroeconomic policy is subjective. The fact that teams are playing against the computer environment, which is not affected by any other player, provides the basis for competition among teams. The excitement of the final few decisions can be quite intense.

Directed learning. Unless students are able to interpret the many indicators produced by RBE, they have difficulty understanding where they went wrong. This analytical skill can be achieved only with experience. The teacher fosters this skill by commenting on performance both during and at the end of the run. There is no inbuilt directed-learning feature in RBE.

Portability. It is not possible for the average student to take RBE home and work individually; this situation may change if PCs become household items. We have encountered cases where school students work on the simulation after school hours.

Enjoyment. Most educators were highly skeptical of RBE when it was first introduced into U.K. schools, arguing that the typical attention span of high school students was a lot less than three hours. The suggestion that it was "playing the computer" that overcame the attention-span problem is suspect because only the team runner, who presents the team's policy changes to a computer operator and receives a hard copy of the output, ever sees the computer. With very few exceptions, the opinion of students and business executives playing RBE is that not only does a lot of learning take place, but it is tremendous fun and very exciting; the computer is perceived as being simply a tool in the process of using the model.

RBE and Teacher Interest

Finally, RBE is attractive to teachers for a number of reasons:

Cost of pedagogy. A computer disk and manual sells for $60 and can be used by many students; thus, cash outlay has never been cited as a deterrent to using RBE. The real cost to the teacher is twofold. First, if integrated into a conventional course, some reorganizing of lectures and timetables may be required. Second, to realize the full potential of the program, teachers have to be thoroughly familiar with the simulation, and learning by doing, that is, running the simulation repeatedly to explore potential inputs and outputs, is the only effective way to achieve this goal.

Significant part of the course. Some teachers build their whole macroeconomics course around RBE, using the manual as a skeletal textbook supplemented by a regular textbook. The manual is written so that students can read the introduction, which briefly describes the simulation; study the history and past policy decisions; and tackle the trial run without exogenous shocks. This process prompts questions such as, "What determines the growth rate of potential output?" and "Will our policy changes affect that growth rate?" Teachers design lessons to treat the topics that the students have encountered in the trial run and prepare students for the simulation that incorporates exogenous shocks. The important aspect of this process is that teachers are teaching macroeconomics within a framework that is both familiar and interesting to students. When RBE is treated as an add-on to a conventional course, the typical student reaction is one of lack of time to give a proper evaluation.

Intellectual springboard. After running RBE, students are ready to be led into the more complex conceptual areas of economics and are better prepared to evaluate alternative economic theories. In addition, it is much easier for the teacher to discuss real-world policy making and its impact on the economy with students who have run their own economy.

Adding a dimension. The problems of teaching dynamic interdependence are almost insurmountable in the conventional class; if the hypothetical objective is to reduce the unemployment rate next year, the classroom answer may be "Reduce the tax rate." The RBE issue is by how much to reduce the tax rate, given that potential output is increasing, that there may have been a devaluation last year, and that some increase in the money supply is necessary to avoid crowding out.

User friendly. RBE is probably the most tested educational software package in the United Kingdom; users are unanimous in their praise of the program design and implementation.

In summary, it appears that the characteristics lacking in RBE, that is, simple applications, directed learning, and portability, have been less important than other characteristics in determining its success.

CONCLUSIONS

The casual empiricism presented here suggests that a successful software package needs to reach the higher levels of the Bloomian hierarchy—meet requirements of real life, fast feedback, team interaction, hypotheses testing, and learning by doing—while providing additional dimensions to teaching and contributing to a substantial part of the course. It is also possible that there are other relevant characteristics that we have not included. What is clear in the U.K. market is that other macrosimulations that deal with simple Keynesian multipliers, some of which we have developed, have not met with high adoption rates because many of the more important characteristics described above were absent.

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