The PLATO system involves communication in two directions. Each student is provided with an electronic keyset as a means of communicating with the computer and a television display for viewing information selected or generated by the computer. The Delphi Exploration is only one of many lessons being written for PLATO. Others include French, Russian, Latin, geometry, genetics, chemistry and maternity nursing.

Exploring the Future with a Computer

Experiments by University of Illinois researchers suggest that computers can give ordinary citizens an opportunity to play an active role in city planning and the formulation of government policy.

by Stuart Umpleby and John Briggs

Bridging the gap between the expert and the layman becomes increasingly important as planning, both short and long range, begins to pervade society. Citizens need to be aware of the alternatives which are available. At the same time, planners can benefit from knowing which alternatives are most acceptable to the public.

Improved understanding between experts and the public is the goal of a computer-based "game" being developed at the University of Illinois. This game, presently called Delphi, involves people as "explorers" of possible future developments. During the exploration they are presented with information about possible occurrences and then are asked to indicate how they would like to change the probability that each of the developments will occur by the year 2000.

The exploration uses the PLATO (Programmed Logic for Automated Teaching Operations) system which consists of a time-sharing computer and a number of student terminals. Each terminal consists of a typewriter-like keyboard by which the explorer enters his responses and decisions into the computer memory. The TV screen immediately in front of the student displays instructions on how to use the keyset (keyboard), directions for playing the game, background information on the developments, and periodic "oracle" messages summarizing the future being shaped by the explorer.

The present version of the exploration describes the future in terms of 40 developments which may characterize the world in the year 2000, such as the development of drugs capable of altering an individual's intelligence, or the appearance of a credit card economy, or the landing of men on Mars. Each development is assigned a certain probability of occurrence by the year 2000. This probability, expressed in terms of a percentage, is presented to the explorer along with some background information to acquaint him with the development.

The explorer then is allowed to "invest" in each development, positively if he judges the event to be desirable, negatively if he considers it undesirable. At present, this "investment" is a number between −100 and +100. The explorer's investment can be interpreted to be a measure of his estimate of the desirability of the development.

Computer Calculates Secondary Effects of Each Investment

The computer then calculates the change in the probability of the development under consideration that results from the explorer's investment. If the investment is positive, the probability will increase; if the investment is negative the probability will decrease. In addition, the computer calculates the secondary effects on other developments that result from the increased or decreased likelihood of this development. These effects are reported to the explorer as changes in the probabilities of the rest of the developments.

The secondary effects of an investment may be partly desirable and partly undesirable. For example, an individual who invests against population planning might find that he had thereby increased the likelihood that his abundant future population would lack food and educational services, and live in a polluted environment. In this way, it is made clear to the explorer that the world is an intricately interrelated system capable of producing unwanted consequences as the result of apparently wise and desirable decisions.

Of course, the exploration would be fundamentally incomplete if information flowed only from the planner to the layman. The data collected during the course of the exploration can be

THE DELPHI EXPLORATION BEGINS FROM THREE BASIC ASSUMPTIONS:

1) THE FUTURE CAN BE DESCRIBED IN TERMS OF SHORT DESCRIPTIVE STATEMENTS WITH PROBABILITIES ATTACHED TO THEM.

2) PEOPLE INFLUENCE THE FUTURE BY MAKING INVESTMENTS OF TIME, ENERGY, AND WEALTH.

3) DEVELOPMENTS, OR DESCRIPTIVE STATEMENTS, ARE INTERRELATED. THE OCCURRENCE OF ONE DEVELOPMENT MAY INCREASE OR DECREASE THE PROBABILITY OF OCCURRENCE OF OTHER DEVELOPMENTS.

THIS SCREEN SHOWS HOW THE PROBABILITIES OF SEVERAL OTHER DEVELOPMENTS WERE CHANGED BY YOUR INVESTMENT IN THE LAST PRIMARY DEVELOPMENT, *GENETIC MANIPULATION.*

SECONDARY DEVELOPMENTS	PROBABILITIES OLD	NEW	CHANGE
SYNTHETIC FOOD	30	28	–2
POPULATION PLANNING	70	74	+4
OCEAN FARMING	30	27	–3
INTELLIGENCE DRUGS	20	26	+6
CLONING OF HUMANS	11	18	+7

GENETIC MANIPULATION

MUCH RESEARCH IS NOW BEING CONDUCTED INTO THE GENETIC MECHANISMS OF CELL REPLICATION. AS MORE KNOWLEDGE IS GAINED ABOUT THE WAY GENETIC INFORMATION IS CONTAINED WITHIN THE DNA MOLECULE, IT MAY BECOME POSSIBLE TO TAILOR THE INHERITED CHARACTERISTICS OF BOTH PLANTS AND ANIMALS. PROGRESS IN GENETIC MANIPULATION COULD LEAD TO HUMAN HEREDITY CONTROL. GENETIC MANIPULATION MIGHT BRING MAN CONTROL OVER SEX, HEIGHT, HAIR AND SKIN COLOR, AND IQ OF CHILDREN.

ORACLE

AS SEEN FROM THE PRESENT, BY THE YEAR 2000 THERE WILL BE:

3-D COLOR TV
WORLD CURRENCY

ACCORDING TO PRESENT PREDICTIONS, BY THE YEAR 2000 THERE WILL -NOT- BE:

STAGGERED WORK WEEK
WEATHER MODIFICATION
LEGAL DECISIONS BY COMPUTER

GENETIC MANIPULATION

THE CURRENT PROBABILITY OF THIS DEVELOPMENT HAPPENING BY THE YEAR 2000 IS *10.*

YOU SHOULD NOW DECIDE WHETHER YOU WANT TO INVEST POSITIVELY, NEGATIVELY, OR NOT AT ALL IN THIS DEVELOPMENT. A POSITIVE INVESTMENT INCREASES THE PROBABILITY OF OCCURRENCE, A NEGATIVE INVESTMENT DECREASES THE PROBABILITY OF OCCURRENCE. INDICATE YOUR INVESTMENT WITH A+ OR - AND SOME NUMBER LESS THAN OR EQUAL TO 100.

→ *+75*

IS THIS OUTCOME CLOSE TO OR FAR AWAY FROM THE FUTURE YOU HAD HOPED TO ACHIEVE? CHOOSE ONE OF THE STATEMENTS BELOW.

A. VERY CLOSE
B. CLOSE
C. SORT OF CLOSE
D. MORE FAR THAN CLOSE
E. FAR
F. VERY FAR

What the Computer Tells the Future-Explorer

Here are samples of displays seen by a student sitting at a computer terminal. The words in bold type are displayed by means of slides. The words in italics represent information plotted by the computers. Any type-style or alphabet could be used either on the slides or for the information plotted by the computer. These displays are intended only to illustrate a few ways in which information can be presented. Which developments the computer reports as being likely will depend greatly on the explorer's investments.

Delphi Exploration vs. Delphi Technique

The Delphi Exploration described here should not be confused with the Delphi Technique originally developed by Olaf Helmer and N.C. Dalkey at the RAND Corporation. At the risk of oversimplification, it may be helpful to indicate their similarities and differences:

Both use lists of developments or events, and both may employ computers. But the Delphi Technique consults experts for estimates of probability, while the Delphi Exploration consults members of the public for estimates of desirability. The two procedures are complementary, rather than competitive.

assumed to indicate what the public wants (developments receiving positive investments), and what is not wanted (developments receiving negative investments). Developments ignored by explorers would seem to indicate areas of less concern. Lack of information on the part of explorers is overcome, to some extent, by subroutines which supply additional information as requested. Explorers also have available a Comment Mode in which they can enter their opinions concerning the adequacy of information provided, the accuracy of the secondary effects described by the program, and other suggestions on how successive versions of the exploration could be improved.

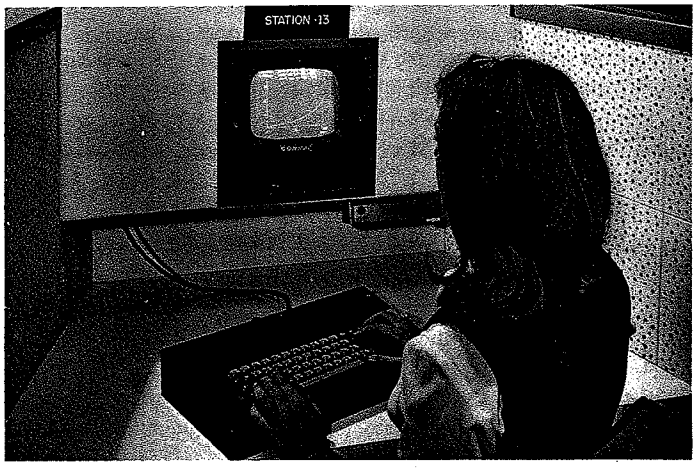
Planners and Public Might Be Brought Together

The "contrariness" of the explorers, contained implicitly in their investments in developments which the experts deem unwise, and explicitly in their Comment Mode opinions and questions, would serve to prompt the experts to review and perhaps totally revise their models of "how the world works." In this way explorations of possible future developments, using teaching computers, could become a new medium for communicating information to the public, presenting them with alternatives, and simultaneously collecting data on which alternatives they consider desirable and which undesirable. Thus experts and the public could be brought closer together in a mutually beneficial exchange of information and opinions.

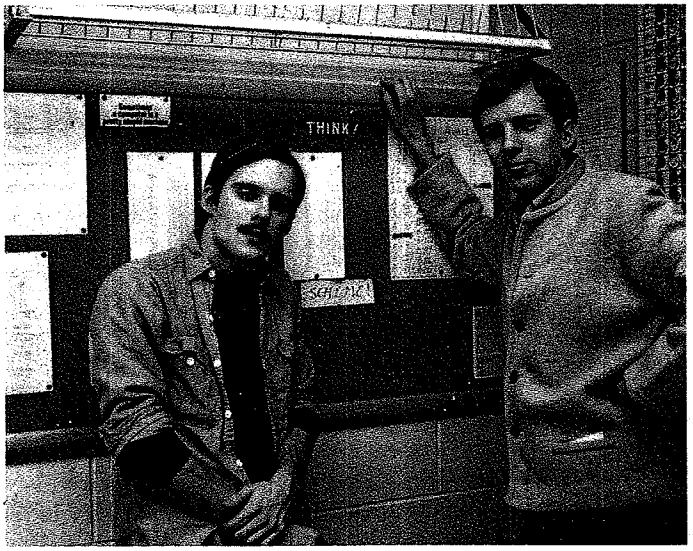
The Delphi Exploration is only a preliminary experiment in developing computer-based "citizen sampling simulations." (We hope that it will not be confused with the Delphi Technique developed by Olaf Helmer and others). The decision-making framework, developed to explore the general problem of the future of mankind, can be easily adapted to more specific problems, such as education, city planning and arms control. All that is needed is to change the developments, the background information, and the matrix describing the relationships between developments. The sequence of decision-making operations used by the explorer can remain unchanged. We think that simulations using teaching computers could become an important tool for involving the public in the formulation of social goals.

Planners and Public Might Reconcile Their Differences

City planners often envisage high-rise apartments and town houses which make a city compact while still providing space for parks and sports-grounds. Many people, however, prefer single-family homes with private yards. Also, if the public were asked how transportation could be improved, they might well respond by recommending more highways and parking spaces and inexpensive smog control devices to be put on automobile exhausts. A planner would probably prefer a rapid transit system linking modular communities.



Student terminal now consists of a television screen and a typewriter keyboard. A device for prestored audio messages under computer control will be available in the near future. For special purposes motion picture films could be used in conjunction with the new terminal now being developed.



Authors John Briggs (left) and Stuart Umpleby of the University of Illinois's political science department, believe the computer can mediate between planners and the public.

If these different points of view are to be reconciled, the public will have to be made aware of all the available alternatives and may need to be reminded that city centers do not necessarily have to be congested, noisy, polluted and crime-infested. Planners should have specific information on the preferences of an informed public to weigh in their considerations along with the more obvious physical and economic factors which have usually been the only factors included in cost-effectiveness studies. A computer-based exploration of alternative urban configurations could probably help to find a compromise between high-rise apartments linked by rapid-transit systems and the current urban decay accompanied by traffic congestion and suburban sprawl.

A group of graduate and undergraduate students at the University of Illinois, drawing upon faculty members as consultants, is beginning to develop explorations of the future of the University of Illinois and the future of the Champaign-Urbana community. These "explorations" will be used to test the feasibility of using "citizen sampling simulations" as an instrument for involving the public in social planning.

A computer-based "exploration of alternative futures" was first proposed by Prof. Charles E. Osgood at a preliminary meeting of the Mankind 2000 group in London in November, 1965. A small group of faculty members and students at the University of Illinois began meeting to discuss the substance of the exploration in the fall of 1966. Programming on PLATO, a computer-based education system at the University of Illinois, began in the fall of 1967. The first public demonstration was given in February, 1968. Modifications and improvements are still being made.

The computer-based exploration of the future described above and the proposed citizen sampling simulations would not be possible without the PLATO system or comparable computer-based education equipment. Donald L. Bitzer, professor of electrical engineering and director of the Computer-based Education Research Laboratory, invented and guided the development of the PLATO system. The plasma display panel, invented by Bitzer and H. G. Slottow for use as a display in the PLATO system, promised to reduce the cost of computer-based education.

Our team is primarily interested in testing the feasibility of using a computer system as a communications medium between planning personnel and the public. We think it shows enormous promise.

(See "A Computer-based Exploration of Alternative Futures for Mankind 2000," by Charles E. Osgood and Stuart Umpleby, in *Mankind 2000*, edited by Robert Jungk and Johan Galtung, University Press, Oslo, 1969. Available from the Society's book service for $14.90. Further information may be obtained from Stuart Umpleby and John Briggs, Computer-based Education Research Laboratory, University of Illinois, Urbana, Illinois 61801)