Meetings

Teaching Machines

The Fourth Symposium on Teaching Machines met between 9 and 13 March 1966, in Düsseldorf, Federal Republic of Germany. The object of these symposiums is to review on-going research, the state of the art, and administrative issues of programmed learning, teaching, and technology. While the previous symposiums were largely limited in attendance and interest to the Federal Republic of Germany, the fourth symposium was an international forum, with participants from European (including East European) nations and the United States. The program provided a forum for both the cybernetic (pragmatic) and the behavioristic (conceptual) approaches to learning and teaching.

L. N. Landa (U.S.S.R.) described a logico-mathematical procedure for determining the structure of certain thought processes, and discussed the problem of automation of the diagnostic process in programmed instruction. Intrinsic and extrinsic programming, to become diagnostic, must assume that (i) structures of mental processes are known and their models written, and (ii) the psychological processes of the student are known and incorporated in the programs. Because an understanding of psychological processes is necessary to correctly identify the cause of error in the thinking process, methods are being developed at the Institute of Psychology in Moscow to study human input-output association processes and their rules. The formalization of this thought process, algorithmically easy to describe (and hence suited for a computer application), permits the introduction of diagnostic procedures into programmed learning and instruction—that is, the determination of the cause of errors. Landa is using the diagnostic method in programmed teaching of mathematics, Russian, and English.

K. Weltner (Federal Republic of Germany) described an application of information theory to programmed instruction. His method uses the simplified Shannon's rating test to determine empirically the amount of subjective information that is contained in recorded materials, such as basic textbooks. In context, the information value per alphabetic character depends on the type of text, the language and vocabulary command of the subject, and previous knowledge of the subject matter. The difference in the amount of subjective information of a basic text, determined before and after the application of a teaching program, is equal to the didactic transinformation of the instruction program. Weltner's technique offers an objective evaluation criterion for teaching programs, without measuring the vocabulary of students or their logical repertoire.

H. Frank (Federal Republic of Germany), whose work stresses algorithmic formalization in contrast to the behavioristic approach, described the optimal teaching algorithm $\Lambda = (Y, R, \phi)$ as the function Λ $(L, M, P, S, Z$, where $Y =$ the teaching steps, $R =$ the reaction of the learning step, $\phi =$ the macrostructure, $L =$ nonredundant teaching materials presented in the basic texts, $M =$ the medium (for example, book, teaching automation, or computer simulation), $P =$ the psychological structure (for example, information psychological model of student, with age-dependent parameters), $S =$ the sociological structure or environmental effect, and $Z =$ the teaching goal (that is, the formulated goal in metalanguage of what elements of L or what deductions from L the student is to learn and with what probability). A partial algorithm has been developed. Although Frank is attempting to formulate a fully algorithmic function, its applications appears to be limited because of the difficulty of algorithmization of Y from L. Combining methods of cybernetic pedagogy with those of automatic documentation and bionics offers promise however.

L. M. Stoluroff (United States) described recent work with the well-documented, computer-based, "Socrates" teaching system. Experiments with its use as an adaptive teacher have included testing the effectiveness of teaching materials compiled and organized automatically on the basis of ascertained psycholinguistic capabilities of individual students.

According to D. Tolingerova (Czechoslovakia) the historical role of cybernetics in education lies in its having added a fourth determinant—control—to the three determinants of the learning process (object, goal, and method). In turn, the present-day significance of programmed learning is based on the fact that it is the only relatively complete and exact system known today by which it is possible to grasp and implement the control aspects of education. Experiments at the Czechoslovak Academy of Sciences indicate that the problem of control of learning is analogous in essence to that of remote control of inanimate objects; there is no immediate knowledge about the object or about its changes. The effectiveness of this psychically communicable control increases with the increasing concreteness of its subjective image—not only the image of the momentary learning situation but also of the entire "history" of learning. The effect of learning is correlated with man's ability to make this "history" concrete and objective.

Several problems exist with respect to integrating programmed instruction with conventional teaching in a school environment: (i) the psychological problem, relating primarily to the difference in demands made on the student by these two methods; (ii) the organizational problem, concerned with the optimum structure of integrated programmed and conventional instruction in view of these psychological differences; (iii) the didactic problem, or the necessity to determine where such integration is possible, desirable, or required; and (iv) the methodological problem of implementing such an integration (A. Witte, Federal Republic of Germany). One method of integration has employed the "open program," 20 to 30 minutes in length and alternated with class instruction in such a manner that the program reinforces the students' moti-

vation and interest in the forthcoming class lecture. The "open program" technique was suggested as a method to make new and larger subject areas of knowledge amenable to programmed instruction.

K. Kroner (Federal Republic of Germany) evaluated an architect's impressions about school buildings in Detroit, Chicago, St. Louis, San Francisco, Los Angeles, Texas, New Orleans, and on the East Coast. He emphasized the versatility of purpose in American school architecture; new teaching approaches such as team teaching; advanced equipment such as tape recorders, radio, film, and TV; and space planning for provision of teaching machines; and the excellence of school libraries, with computers to be located in them in the near future. However, Kroner found no teaching machines in U.S. schools.

R. W. Schirm (Federal Republic of Germany) argued that most programs concerned with continuing education copy the techniques of programmed instruction for school children and hence impose too much guidance on the adult. Thus, such programs negate the professed advantage of this instruction—choice in following individual response. W. Zielke (Federal Republic of Germany) reported on a successful experiment with programmed instruction in industry. Joint use of conventional and programmed instruction techniques (that is, lectures followed by auto-instruction) reduced the learning time of 200 individuals from 20 to 8 hours, yielding 96 percent correct answers in subsequent tests.

Various aspects of work in programmed instruction in Czechoslovakia and Bulgaria were described. J. Kubálek (Czechoslovakia) classified learning and teaching media from the viewpoint of information theory. Several Czechoslovak experiments in programmed instruction of school children and adults were described; very favorable results have been obtained in a 3-year experiment to teach Czech grammar to 11-year-old students. As a result, the experiment is being extended to cover 700 students, according to M. Milan (Czechoslovakia). W. Hubner (Federal Republic of Germany) outlined a technique for compiling, through specially designed tests, an "error index" which eliminates unnecessary and improbable branching in program writing.

A. Šatánek (Czechoslovakia) described a fairly comprehensive effort in programmed health instruction in Czechoslovakia in which several audio-visual and programmed teaching devices that he developed are being used. Experimentation with programmed instruction and learning at the University of Economics in Prague, emphasizing auto-instruction in foreign languages, was outlined by V. Štěpán.

A. Heipcke (Federal Republic of Germany) attempted to approximate deductively the empirical learning function of Hull [*Principles of Behavior*, New York (1943)] and to define its range of validity; the resulting generalization may possibly be relevant for more complex learning processes. A large-scale effort (K. Günther) has been under way in East Germany for several years to collect data from theoretical and experimental studies; certain phases of learning and teaching foreign languages can now be formalized. These are formulated in terms of didactic and methodological guide rules, said to be based on proven scientific premises, which find application in teacher education.

The program of the working groups was less formal in the sense that it concerned itself at least partially with problems of narrower scope, often limited to the experience or practice of an individual group or situation. Included were several demonstrations of locally manufactured devices and experimental products, most of them relatively unsophisticated and inexpensive.

In practice, programmed instruction is still in the experimental evaluation stage in the Federal Republic of Germany. However, plans are being discussed for its more formal introduction on a broader scale, primarily at the precollege level. There are many inexpensive devices for auto-instruction. Work on more complex learning devices is being done at the Center for New Learning Processes at the University of Tübingen, and at such private institutions as the I.L.S. Economic Institute for Learning Systems, Inc., in Frankfurt. All the teaching universities of the Federal Republic of Germany are in some measure concerned with programmed instruction, especially the German Institute for International Pedagogical Research in Frankfurt. No evidence was found of any large-scale system of computer-aided instruction either in existence or being implemented, or of any significant work in the design of question-answering systems such as has gone on in the United States for the past 5 years.

The European interest and work in the area of programmed learning and teaching indicate that future symposiums may become an annual international event of major importance in this field in Europe.

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Mental Retardation

Many cases of mental subnormality resulting from infectious diseases seem to escape the epidemiologists today. More exacting techniques of epidemiology and more precise measurements are required. The incidence of iatrogenic brain damage needs to be reduced. Also, there exists a large gap between knowledge and utilization of preventive techniques.

These subjects were the main topics discussed at a recent research conference on the Prevention of Mental Retardation through the Control of Infectious Diseases, held in Cherry Hill, New Jersey, 9–11 June 1966. This conference was the first of a series to be held on the recommendation of the President's Panel on Mental Retardation. Participants represented the United States, Mexico, Sweden, Denmark, and Austria.

In surveying the literature, Berendes (National Institute of Neurological Diseases and Blindness) said there is considerable knowledge about many infectious agents that contribute to mental retardation but little precise information on the incidence. Mild forms of retardation are considerably more frequent than severe cases but are rarely reported, and the data even for severe cases are not precise since information about infectious disease is often based on recall. Many infections, particularly viral ones, present a mild or atypical clinical picture, and often are not recognized. Berendes cited three attempts to estimate infectious disease etiologies in groups of men-