Teaching the use of computers to university agricultural students of the Middle East

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When working with students of agriculture from the economically underdeveloped areas, one is tempted to plug a student into a computer program and forgo instruction in the use of computers. Alternatively, one may use methods of quantitative analysis or select research problems which would allow computer use to be circumvented. Another rationale for neglecting training in the use of computers (particularly in economic or social research) is the limited availability of usable data.

The thesis of this paper is that it is a serious mistake to succumb to these temptations and neglect the education of Middle Eastern students of agriculture in computer use. Although the quality and quantity of statistical data and the availability of research funds to generate primary data are presently limiting factors, the students we train today will be in key decision making positions 10 to 15 years from now. Training which is carefully designed to meet the needs and aptitudes of these students can prevent a serious divergence in attitudes and understanding from developing within national institutions or organizations in future years. Bureaucratic structures in government ministries and continued adherence to seniority promotion systems make it imperative that senior administrators have an appreciation for the uses of computer systems.

A. OBJECTIVES OF EDUCATION IN THE USE OF COMPUTERS

The objectives of an educational program in computer use, at an institution such as the Faculty of Agricultural Sciences at the American University of Beirut, must reflect the special requirements of students from less developed countries. The following objectives are based on the experience of faculty members in various disciplines in the agricultural sciences and the staff of the University Computer Center.

1. Establishment of a facility for communication with the community of computer users and the computer center.

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2. Replacement of fear or fascination with a realistic appreciation of the usefulness of computers, destroying myths regarding the capabilities of the computer.

3. Instruction of the student in the organization of research activities in a manner to facilitate computer use.

4. Establishment of an appreciation for the necessity of exactness and completeness in working with electronic computer systems.

5. Provision of a basis for choosing between mechanical and electronic computing equipment for specific analytical tasks.

6. Establishment of an understanding of the importance of employing highly trained personnel in the generation or assembly of data for analysis by electronic computers.

These objectives are based on (a) the attitudes toward computers exhibited by University students, (b) the views of faculty members on feasible applications of the computer in graduate student related research projects and (c) experience in teaching the use of computers.

B. STUDENT ATTITUDES TOWARD USE OF COMPUTERS

The general experience of agricultural scientists instructing undergraduate and graduate courses at A.U.B. has shown that much adaptation is required in teaching methods and in design of courses. This is due to the quality and type of primary education in the region and the work experience of these students.

Comparative attitude of U.S. or European students and students from middle. Eeastern countries.

Agricultural students from Middle Eastern countries generally differ substantially from European of American agricultural students in their attitude toward the computing revolution. The latter are largely convinced of the inevitability of computerization and many enthusiastically search for ways in which to bring the computer to bear on their own research and future professional activity. The novelty of computers has begun to diminish for these students and they are able to consider it as simply an additional device for facilitating complex computational tasks involving large volumes of data.

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Photo Roger Viollet

Students from Middle Eastern countries, however, tend to be either baffled by the subject or highly skeptical of the applicability of computer systems to their own situation. Attitudes are influenced largely by the type of educational systems in area countries.

Influence of the level and type of education on the attitudes of students.

The incoming undergraduate may only be aware of space travel and similarly dramatic applications of the computer. Because he associates competing systems with activities remote from his experience and expectations it is difficult to instill a realization that he has suddenly become a member of the community of people who are concerned with the uses of these " mysterious " machines and even wish to involve him in such activities.

Holders of the B. Sc. degree from Middle Eastern colleges and universities generally are poorly prepared in statistical methods or concepts. The general lack of basic courses in logic and scientific methods is also inhibiting both in establishing a positive attitude and facilitating understanding of the manner in which computer systems function.

Influence of work experience on attitudes of students.

Many of the graduate students (B. Sc. holders) entering the Faculty of Agricultural Sciences have extensive experience in their various professions. Frequently these students are on leave from positions with governmental agencies serving the agricultural sector. The experience of working in these agencies may create negative attitudes toward computer use for several reasons.

In all phases of the graduate program of A.U.B., emphasis is placed on improving the quality of the students performance. The student is encouraged to be objective, impartial and precise in his scholastic activities. He knows, however, that when he returns to his country, he will be employed in an " underdeveloped " agency. The quality of data with which he must work and the lack of motivation on the part of low paid governmental employees cause such students to despair of putting computers to effective use in the job to which they are committed to return. These students justifiably doubt the wisdom of computerization under conditions existing in their own community and are pessimistic regarding the likelihood of an early institutional change which might open the way for effective use of electronic data processing equipment.

The attitude of the more experienced graduate student varies with the type of experience attained. Students in the social sciences may be particularly difficult to reach because of the difficulty of improving the quality of economic and social statistics in less developed countries. Students in agronomy may be more easily encouraged to turn to the computer for assistance.

Students in general are concerned with the problem of unemployment. The computer is an obvious labor saving device and this may also contribute to a negative attitude.

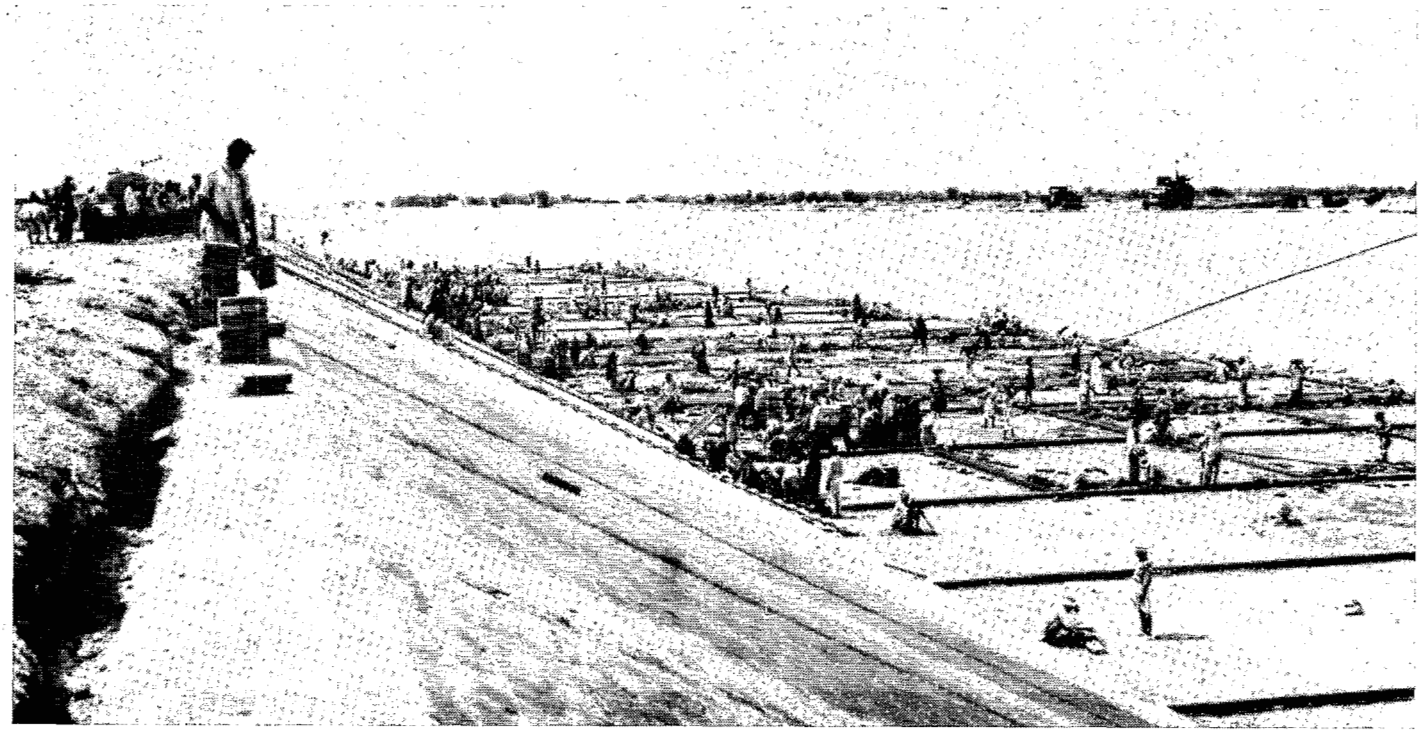
C. APPROACHES TO STUDENT COMPUTER USE AT THE AMERICAN UNIVERSITY OF BEIRUT

The various approaches taken to teaching the use of computers at A.U.B. are discussed in Section D. The general experience of the faculty suggests that none of these can completely substitute for setting students to work with the computer, as this experience achieves two of the prior stated objectives : overcoming negative or ficticious ideas about the computer and convincing the student of the exacting demands placed on the user.

A " computer laboratory " is much more difficult to organize than the " statistical laboratory " commonly employed in applied statistics courses. The high cost and limited availability of computers for training purposes necessitates extreme care in the selection of computational exercises for students. For purposes of this discussion the computing activities generally taking place in a University environment may be classified as (1) Comprehensive Computing, (2) Staged Exploratory Computing and (3) Specialized Programming. This classification is based on the working relationship between the University Computer Center and the faculty it serves. Student training must be conducted so as to provide the greatest experience while placing as little demand on the staff of the Computer Center as possible.

Comprehensive Computing is the use of " library " programs which handle complex computational tasks common to many different research or operational situations. Multiple regression and linear programming are examples of such computing activities, the former being used to " fit " mathematical functions and the latter to solve maximization (or minimization) or allocative problems. Such computing activities are of relevance only to students engaged in graduate research.

Staged Exploratory Computing involves the use of " library " programs which handle relatively simple compu-



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tational tasks which are time consuming if done on a calculator. The computation of means and medians, standard deviations, frequency distributions, ranges, chi square and analysis of variances are examples. This type of computer use is suited to training activity as it involves operations which are known to the student through his course work. Students may gain this experience while assisting faculty researchers in exploratory research or as an integral part of quantitative research methods courses. The student experiences organization and presentation of data for computer analysis and witnesses the benefits.

Specialized Programming is a general term referring to any computing activity which requires extensive services of a computer programmer. Such activities range from highly complex simulation models to relatively simple operations such as account billing. In each case, however, the computational task must be stated in such terms that a Computer Center programmer can quickly write an efficient program. Alternatively, the computer user may write his own program. This type of training experience is generally beyond the capability of the University Computer Center. Graduate student research assistants may have some experience at this level through their association with staff level research. The experience of "talking" to the computer is definitely desirable as this provides insights into computer systems otherwise difficult to convey. This activity requires extensive study and is best integrated with formal course work.

D. TEACHING THE USE OF COMPUTERS

Several formal and informal approaches have been used to teach the use of computers throughout the world. At the American University of Beirut agricultural students may receive training in the use of computers in one or more of the following ways :

1. Informally, through *tutorial type individual (or small group) orientation sessions.* These may be (a) of a general nature in which the student is given a superficial familiarity with the computer center or (b) of a specific nature in which the student's individual research project is serviced by the personnel of the computer center and the students major advisor.

2. Formally, through an *undergraduate level course to introduce electronic data processing techniques and equipment* which emphasizes :

a. The different uses for tabulators, calculators and electronic data processing equipment.

b. The steps for preparing raw data for electronic computer analysis.

c. The basic principles and mechanical techniques by which the computer functions.

d. The administrative uses which agri-businesses can make of computers, for example, payrolls, accounting, budgeting, and automatic inventory updating.

3. Formally, through *undergraduate and graduate level courses to teach computer programming* which emphasize :

a. The concept of stored programs.

b. Programming with formula translation or FORTRAN language.

c. Handling of constants, variables and subscripts.

d. Arithmetic statements.

e. Control statements.

f. Specification statements.

g. Input-output statements.

h. Subroutines.

i. Debugging and testing techniques.

j. Writing efficient programs.

4. Formally or informally, computer use is taught to agricultural students through *research methodology training sessions in specific areas of subject matter specialization.* For example, in the Agricultural Economics, Extension, and Sociology Division, graduate students are taught the following to help them collect, prepare, and plan for the use of data destined for computer analysis :

Sources of bias in sampling. Poor survey, design, poor sampling procedures, and poor implementation of the survey are some of the general sources of bias in sampling.

Estimation of sample size. Given (a) the estimates of the variance of the population, (b) a specified level of accuracy desired, and (c) a specified risk that the researcher would be willing to take regarding the level of precision desired, a statistician may provide the tools to estimate a sample size that satisfies the precision required for items of a survey. However metastatistical considerations also enter the picture. Budgetary, manpower, time and material limitations may determine in advance the sample size at the expense of precision. The researcher must strike a balance between the precision desired and the resource limitations.

Stratification in sampling. Stratification is an important sampling procedure for increasing precision of estimates. Stratification may be introduced at either the data collection or the data analysis stages of research, but in the former it is possible to exercise more control in the sample size obtained from each stratum and thus to increase the efficiency of the research methodology.

Classification and measurement of data. Considering the practical pro-

blems of research the initial task to be dealt with is classification of the data -- e.g., distinguishing between quantitative and qualitative data, distinguishing between discrete and continuous variables, etc. The logic of classification is essential to the sound use of statistical methods -- e.g., using the statistical methods most appropriate for the different types of measures (nominal, ordinal, interval and ratio scales, etc.). Scientists need to know the logic of measurement underlying the treatment of the data. They also need to know how to handle discrete data which first need to be classified and then describe the results through the use of the appropriate statistical techniques.

Design of questionnaires. Some of the important aspects to consider in developing a questionnaire are (1) distinguishing different types of interviews and questionnaires, (2) the purpose of each question, (3) the wording of each question, (4) the organization of the questionnaire, (5) how the information will be coded for computer analysis, (6) pre-testing and revision, and (7) how to conduct the interviews most effectively.

Coding and card punching. Moving data from the questionnaire to the computer involves (1) coding the questionnaire, (2) entering the coded information on the coding sheets, (3) punching the coded information into the cards from the coding sheets, and (4) listing the punched cards to check for errors in punching.

Computer constellations and their functions. Computer constellations introduced are input devices, central processing units, output devices, and auxiliary equipment. Computer programming and computer language are introduced. Some of the uses and limitations of the computer are explained.

In summary, effective instruction of Middle Eastern agricultural students in the use of computers requires both " laboratory " or operating experience and a solid link to basic courses in research methodology, logic and statistics. An extra effort must be made to achieve an understanding of the basic concepts relating to the mechanics and flow of activities in electronic computing. This is best achieved through actual experience in programming standard computation tasks stemming from research or courses in which the student is engaged.

CROISEMENT DE TECHNOLOGIES

L'expérience tend à montrer que les innovations véritables de notre époque résultent le plus souvent d'un « croisement de technologies », lorsqu'une technique développée dans un secteur en atteint un autre.

Ainsi, la technique des calculateurs, après des débuts prometteurs dans les domaines de la comptabilité et du calcul scientifique, a vu ses applications se multiplier et a pénétré un secteur industriel après l'autre (2 applications en 1952, 300 en 1960, 500 en 1962 et 1 000 en 1967).

Cette technique s'est elle-même enrichie par un croisement avec d'autres techniques, électroniques et optiques, ouvrant ainsi la possibilité de nouvelles applications à des domaines encore considérés comme relevant de l'art : dessin, musique, poésie, photographie, peinture, etc.

Le dessin avec l'aide de calculateurs s'est révélé particulièrement intéressant. Non seulement il permet une reproduction graphique de calculs, mais aussi il rend possible la simulation, et par là, un choix rationnel entre des solutions possibles. En même temps que les techniques de dessin automatisé se perfectionnaient dans les industries aérospatiales, de nouveaux équipements étaient élaborés, rendant possibles de nouvelles applications : automobile, engineering, construction navale, cartographie, cinéma (dessins animés), etc... Ceci n'est naturellement qu'un début, car d'autres « croisements de technologies » sont en cours, notamment dans l'application du calculateur à la photographie, qui a montré la possibilité de placer directement des images en mémoire et de les traiter comme de l'information (cette solution, actuellement au stade de développement, n'a pas encore atteint le dessin automatisé).

Divers travaux de recherche poursuivis ces dernières années sur l'application du calculateur à l'art (poésie musique, peinture), sur l'intelligence artificielle, sur le comportement des individus, etc. ont montré que le dessin automatisé pouvait intéresser l'urbanisme, l'architecture, plus généralement la construction et bien entendu la cartographie.