Recent developments in computers and society research and education

by RICHARD H. AUSTING
University of Maryland
College Park, Maryland

and

GERALD L. ENGEL
Old Dominion University
Norfolk, Virginia

INTRODUCTION

Since the advent of computers, there has been concern about the impact of computers on various aspects of society. Thousands of articles and numerous books have been written in the general area of computers and society. Computer professionals have been instrumental, though perhaps not always significantly enough, in the development of policies and legislation affecting the use of computers in the public domain. Studies have been conducted; courses have been introduced, primarily at the college level; seminars directed to computer professionals have been held; and public information programs have been sponsored, mostly on a local level.

While much of this activity is continuing, a number of developments during the past few years suggests that new (or renewed) emphasis is being placed in certain areas, particularly in research and education.

RESEARCH

One indication that research activity in any area is increasing is the establishment of a journal or section of a journal for publication of results. Research papers in computers and society have been appearing regularly in the Communications of the ACM since January, 1976 when "Social Impacts of Computing" was made a separate Technical Department with its own editor (R. Kling, University of California at Irvine). Also, the conference ACM 78 which was held in Washington, D. C. in December, 1978 included two sessions on research in computers and society. Six papers were featured in these sessions.1

Books have appeared which give more stress to issues in the area of computer impact on society and analytical perspectives of the subject matter rather than expository treatments of applications as found in many works. Examples of the former are books by Arbib, Gerberick et al., Gotlieb and Borodin, Hoffman, Mowshowitz, and Weizenbaum.2-5

These kinds of books are useful for computer professionals as well as for upper division or graduate students in a computer oriented degree program.

EDUCATION

Recent curriculum recommendations from ACM's Curriculum Committee on Computer Science (C'85) include an advanced-level course in Computers and Society. The report "Curriculum 78: Recommendations for the Undergraduate Program in Computer Science"6 specifies that the course at least be strongly recommended and should be required of all computer majors if sufficient material is not included in other required courses in the program. This recommendation constitutes one of the major differences between the report "Curriculum 78" and the same committee's report ten years earlier7 which did not include a course on computers and society.

Another recent development within ACM is also worth noting. The Elementary and Secondary Education Curriculum Committee, in December, 1978, began work on recommendations for material on computer impact to be taught in elementary and secondary schools. It is too soon to comment on this development, but the effort itself is significant.

CERTIFICATION

The Institute for Certification of Computer Professionals (ICCP), established in 1973, has exercised concern over the societal responsibilities of computer professionals in a variety of ways. In 1977, ICCP offered the Certificate in Computer Programming (CCP) examination which attempts to test minimum knowledge requirements for persons holding senior programmer positions. The content outline for the examination contains a section on computers and society.
ICCP also offers the Certificate in Data Processing (CDP) examination which is oriented toward management positions. Anyone who passes these examinations is expected to subscribe to codes of ethics and good practice (which were developed by ICCP) in order to obtain the certificate. Although relatively few (less than 20,000) persons hold the CDP and only several hundred hold the CCP, there is active discussion on the use of these examinations and examinations for other positions under consideration by ICCP as part of the minimum requirements for appointment or promotion to certain positions. This issue is a complex one with ramifications that are not subject matter for this paper. However, the institution of such requirements as criteria for obtaining a job title or, more importantly, for carrying out the duties of a position, will increase the awareness of computer professionals of their societal responsibilities.

For example, consider the development of an automated diagnosis program. A number of them have been implemented and more sophisticated ones are likely. Some of these programs have resulted from the interaction of medical personnel who knew relatively little about computers and programming and one or more programmers who knew relatively little about medical applications and who may not have known as much as one would like about programming, data structures, and relevant techniques. Who is to blame if a patient suffers because of a wrong diagnosis? Does the programmer have any responsibilities in this regard? Should a programmer be required to pass an examination such as the CCP before being placed in charge of the programming project? Certainly, there is no guarantee that persons will obtain a new title, but the intent would be to make them more accountable, hence, we hope, more concerned.

CODES

Within the last few years, codes of ethics, conduct, or good practice have been established by a number of computer societies (e.g., ACM, ICCP) which suggests the memberships' growing awareness and concern over the impacts of computers on society. Members are expected to subscribe to the codes, but computer societies have found it difficult if not impossible to enforce their codes. In an attempt to remedy this problem, the ACM Council at its meeting in June, 1978, adopted enforcement procedures for its Code of Professional Conduct after extensive discussion both at this meeting and at previous ones. The text of the procedures was published in the August, 1978 issue of the Communications of the ACM.

NSF GRANT TO ACM

In 1974, work began on a project of ACM's Education Board funded by NSF and entitled "A Study of Computer Impact on Society and Computer Literacy Courses and Materials." The project had three basic objectives:

1. To review and catalog materials related to computer and society courses and programs and to provide methods for dissemination of such information.
2. To identify minimum-knowledge-level requirements for computer literacy.
3. To develop behavioral objectives for various types of computer and society courses as well as develop decision mechanisms for materials for such courses.

Bibliography

The project committee's efforts to achieve the first objective resulted in 1976 in an annotated bibliography of over 2000 selected entries (dated, for the most part, after 1968) which was intended to provide resource material for teachers of both computer impact on society and computer literacy courses. A hierarchical information storage and retrieval system was developed and implemented under Charles H. Davidson at the Engineering Computing Laboratory, University of Wisconsin—Madison. Entries were coded by area, function, approach, level and type. Retrieval of all entries satisfying combinations of these categories was possible.

A review of the kinds of material written in the area of computers and society, and included in the bibliography, can be found in Austing, Cotterman, and Engel. Briefly, the review indicates that over 90 percent of the material was expository in nature, ranging from the wonderment (e.g., computers are superior to humans) and fear (e.g., computers will cause vast unemployment) found in earlier literature to the more detailed discussions of applications found in later material. A very small percentage of the literature contained technical perspectives. We hope this percentage is increasing as suggested by the examples cited in previous sections.

While the bibliographic work was underway, the project committee participated in panel sessions and held open hearings at conferences, in addition to discussing ideas and experiences of interested and knowledgeable professionals from education, industry, government and selected groups from the public-at-large. These efforts provided substantial input relative to course content, educational level, minimum requirements and objectives of courses in computer impact on society and computer literacy.

The second phase of the project, also funded by NSF, began in July, 1977 and will continue into 1979. The following three activities were specified:

1. Further develop and refine the bibliography and the information storage and retrieval system supporting it.
2. Organize and conduct a workshop on computer impact involving individuals other than computer professionals.
3. Develop and disseminate a collection of position statements in the area of computer impact by various concerned professionals.
The workshop

The workshop played a major role in the approach to the other two activities. It was held on July 17-19, 1978 in Williamsburg, Virginia. The 33 invited participants represented as diverse a group as possible, the only common bond being an expressed interest or experience in one or more aspects of the societal impact of computers. Austing and Engel report on the organization, content and results of the workshop. Some of the results and recommendations lend emphasis to the fact that there are renewed efforts lately in the area of education regarding computers and society.

Specifically, a list of topics was developed from which course material could be used. This list did not constitute a taxonomy, nor was one expected at this stage. However, whenever a topic is selected for presentation, it is necessary to determine the level (impart knowledge, instill an attitude, develop a skill), audience and approach (lecture, discussion, examples only, technical aspects, project, etc.). Further, when developing material possible emphases must be considered, such as

1. Skills citizens need for coping with the computer impact.
2. Computer impact on work patterns and relationships within organizations.
3. Degree of high technology comprehensibility of professionals.
5. Inherently socially problematic nature of computer technology.

The growing interest and public support for the computer literacy concept was cited as a reason to consider including suitable material at the pre-college level. More strongly, the workshop participants recommended that all high school graduates be computer literate. The rationale focused on the necessity to learn about computers before formal schooling is completed because computers do (and will continue to) permeate our society. To achieve the desired computer literacy, graduates should have knowledge of the following:

1. Historical perspective of computing.
2. Computer anatomy (includes parts of a computer, how computers work, algorithms, problem solving, system capabilities).
3. Uses of the computer (both types of uses such as information storage, simulation, DP, communications and areas such as business, science and technology, education, health care).
4. Social implications (such as careers, organizational changes, privacy).
5. Futuristics (for example, trends in artificial intelligence and robotics, innovation and new technology, communications).
6. Introductory level skill in algorithm design and programming (only if adequate access to computers is available).

At the college level, two kinds of courses were specified, one for the general education requirement (designed as a survey type course) and one for the computer science major (designed to help students learn to carefully analyze the social settings in which computing is used, to understand what social and historical forces give rise to different systems uses and designs, and to realize the impacts and value conflicts upon users and non-users of computers). The workshop participants recommended that a Computers and Society course, or equivalent knowledge, be a part of the education of every college student. Rationale cited the imperativeness for college-educated persons to have more than a superficial knowledge of computers and their impact because of the technical/information explosion and the corresponding expansion in computer usage, the need for the corresponding expansion in computer usage, the need for awareness about computers in consumer life and the need for a more informed citizenry in decision making where computers are involved.

Imparting knowledge to computer professionals and reaching them are two problems addressed by workshop participants. Delivery mechanisms (e.g., courses, professional development seminars, tutorials) must be intensive, be appropriate to the job environment and be geared to very specific groups. Computer professionals have a difficult enough time trying to keep up-to-date in their specific area. They will not always find the time to attend courses or seminars for the purpose of keeping abreast of the impact of computers in such wide-ranging areas such as transborder data flow, electronic funds transfer, communications and health care. They need a set of principles rather than broad knowledge to apply to societal impact issues relevant to applications in which they are involved. These principles can be developed through a highly-concentrated approach to a specific issue, possibly by means of a case study approach or by simulations and role playing.

The general public needs to be educated about computers but effective means are difficult to identify. Every computer professional can play a role in educating the public and, by so doing, put into action various aspects of social consciousness that would otherwise just be words. The public is inundated by computer applications (e.g., charge accounts, graphics on TV, advertisements, electronic games). Computer professionals could not only offer continuing education courses to transmit correct information to portions of the public, but also exert whatever influence they have (possibly through computer societies and associations) on business and government to promote policies encouraging proper use of computers where the public is involved. Workshop participants identified a number of specific information media and suggested uses of media groups for disseminating material about computers to the public. However, no readily available solutions were found.
One of the outcomes of the workshop was to broaden the base of material in the bibliography developed in the first phase of the grant by incorporating references from fields other than computer-oriented ones (e.g., philosophy, health care). The bibliography was also updated by adding more current references and, in some cases, deleting some which have been superseded or which were not as good a source as another reference. The bibliography now contains over 3000 entries and is a much more valuable resource to anyone intending to offer a course in the computer impact on society or computer literacy. After the termination of the grant in the spring of 1979, ACM will begin maintaining the bibliography. Information concerning its content and use can be obtained through ACM.

CONCLUSION

The activities previously described indicate the kinds of efforts underway in the area of the computer impact on society. They are at the level of affecting professional organizations of computer people and having an impact on schools, especially elementary and secondary ones. Research results are being disseminated more widely than before which, in turn, should encourage more creativity and development by people concerned with societal issues. All of these are hopeful signs of renewed emphasis on important issues in computers and society.

REFERENCES


From the collection of the Computer History Museum (www.computerhistory.org)