DOCUMENT RESUME

ED 273 556 SO 017 538

AUTHOR Beins, Bernard C.
TITLE Computers as Teaching Tools: Some Examples and Guidelines.
PUB DATE Oct 85
NOTE 25p.; Based on a paper presented at the Annual Mid-America Conference for Teachers of Psychology (2nd, Evansville, IN, October 18-19, 1985).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Computer Literacy; *Computer Oriented Programs; *Computer Simulation; Computer Software; *Educational Technology; Higher Education; *Instructional Innovation; *Microcomputers; *Psychology; Teaching Methods

ABSTRACT

The use of computers in the classroom has been touted as an important innovation in education. This article features some recently developed software for use in teaching psychology and different approaches to classroom computer use. Uses of software packages for psychological research designs are included as are applications and limitations of computerized teaching tools. Advantages and disadvantages of word processing and statistics packages are described, and applications and recommendations for software use are presented. Two software programs which were specifically designed for instruction are reviewed. Psychworld, written for an introductory psychology class, is a fourteen set package involving a combination of graphics and text. Basic Electrophysiology is a home grown program for advanced students, consisting of a series of programs aimed at teaching the student how nerve action potential occurs. Basic Electrophysiology is to be used on an individual basis, whereas some Psychworld modules could be used for large audiences. Since many people are developing excellent software but not marketing it, a Clearinghouse for Teaching/Learning Activities in Psychology has been established at the University of Southern Indiana (Evansville) to encourage the use of computer-oriented teaching aids. Using software for teaching and learning processes requires the instructor to assess student needs and software quality. Increasingly student needs and wants can be met by appropriate hardware and software. Figures from Basic Electrophysiology, a listing of areas of psychology software developed for personal use, and an appendix which list programs written as teaching tools are included. (APG)

Computers as Teaching Tools:

Some examples and guidelines

Bernard C. Beins

Ithaca College

Running Head: COMPUTERS AS TEACHING TOOLS

Abstract

The use of computers in the classroom has been touted as an important innovation in education. This article illustrates some recently developed software for use in teaching psychology as well as different approaches to computer use in the classroom.

Computers as Teaching Tools:

Some examples and guidelines

Bernard C. Beins

Ithaca College

Computers have been around for a couple of decades now; personal or departmental microcomputers started arriving about one decade ago. There is an increasing acquisition and use of the microcomputers and the result has been a steadily increasing supply of software and a concomitant demand along with it. This paper will present some specific approaches to using the computer as a teaching tool and some illustrations of how sophisticated computer use by non-professional programmers has developed.

This discussion is going to focus on two points: the perceptions of psychologists and of students as to what kinds of things students need in the educational process, and the actual use of microcomputers in the teaching process in helping to achieve our goals.

As Norman (1984) noted, there are various levels of computer literacy. They involve (a) understanding general principles of computation, (b) knowing how to use computers, (c) knowing how to program, and (d) understanding the science of computation. As teachers and users of computers, many of us will ultimately be at the third stage, if we are not already. We will be in decent shape, at least for now, at the second stage. However, we should not expect that the majority of our students are really into the first stage. In the present discussion, I will provide some suggestions that I hope will help us relieve our students of the timidity that they often show toward computing machines. After all, "computers are tools, and should be treated as such; they are neither monsters nor savants, simply tools, in the same category as the printing press, the automobile, and the telephone. And like these examples, they have the power to transform our lives" (Norman, 1984, p. 225).

WHAT DO STUDENTS NEED AND WHAT DO THEY WANT?

A brief review of recent publications indicates some common themes that reveal what we, as teachers, think that we need to provide for our psychology majors. These general areas include (1) oral and written skills (Boice, 1982; Costin, 1982; Klugh, 1983), (2) skills oriented toward research applications and data interpretation (Costin, 1982; von Swenson, 1982), (3) study management skills (Grabe, Petros & Mann, 1984), (4) on-line bibliographic search abilities and other computer-use skills (Collyer, 1984; Makosky, 1985) and (5) that vague terrain known as marketable skills. The first three of these themes mentioned probably fall into the marketability category, although it seems that students are not aware of it. In fact, there seems to have been remarkably little published concerning specifically what constitutes marketability. An additional area of use for our students would be 5) professionally oriented skills (Swenson, 1982; Lupo & Ware, 1984), although these are more likely to be important at the post-bachelor's level.

Once it has been established what we think our students need, we should find out what they want. Given our perspectives as educators, it is not surprising that there is less publisheld material in this realm. Most students would claim a need for 1) those "marketable skills", as well as 2) self-help skills (von Swenson, 1982; Pettijohn, 1985). Finally, there is always the need to impart to our students substantial content from the courses we teach.

One question we need to ask concerning microcomputers is whether they can help us meet the needs of our students. It is clear that there are some domains in which computers will not be especially effective in any direct sense. One such area is that of oral skills. To date, I have seen no claims that there is any software that will enhance oral communications. As we all know, marketers of software are generous in their own estimation of their products; if none of them is willing to say that their products will help oral communication, then I would be willing to believe that there isn't anything out there.

Further, it has been suggested (Lancaster, 1985) that educational software must meet the 3-B criterion: boring, banal and bug-ridden. Any of these criteria alone is sufficient to bring student learning and enthusiasm to a screeching halt, especially if the students are intimidated by our computing machines. Most of us have probably had direct evidence with such software, whether we have written the programs ourselves or whether we acquired them through software vendors.

Fortunately, however, for a number of applications, there is reason to believe that useful software is available. I will present some of the specific instances of software that are helpful, as well as some general categories.

SPECIFIC APPROACHES TO USING COMPUTERS AS TEACHING TOOLS

One of the myths that seems to have sprung up about students and computers is that the students have a high degree of sophistication and comfort with them. As Beins and Porter (1985) suggested there are still large numbers of students who are intimidated by computers and who have few ideas as to what these machines can do. There seems to be a risir trend, however, to incorporate these computers into a diversity of learning activities in psychology. We try to get our students to use our Apple systems for data collection and analysis, and then for word processing as they write research reports.

The first question here involves the areas of psychology that might benefit from computer use in teaching. The most obvious examples are areas like statistics, where drill and practice can be done for as long as the student is willing to sit at the keyboard. There are also various test diskettes, provided by publishers of textbooks, which could be used as preliminary or practice tests; these diskettes can also be used for actual test use. The next area that has benefited from computer availability is learning and cognition, where the stimuli can be presented and the responses to those items can be recorded. This is, perhaps, the most obvious content area in which computers are used.

Outside of these areas, there is still a potential for other applications, although the software is just beginning to appear. A partial listing of programs already available is given in Table 1. This listing by no means exhausts the extant software. Any presentation of non-commercial software is necessarily limited because the programs are developed by psychologists for their own use, and, consequently, not many people know about these applications. This ignorance of the good software that has been developed may be remedied by the Clearninghouse for Teaching/Learning Activities in Psychology that has been initiated by Joe Palladino at the University of Southern Indiana. The Clearinghouse is intended to provide teachers of psychology access to activities and demonstrations for classroom use; these learning aids will include, but not be limited to, computer applications. The programs listed in Table 1 are quite well done; I suspect that there are many times this amount of software that lurks unused across the country, just waiting to be tapped. It needs to be pointed out that the individuals doing this are not professional programmers, but rather very creative psychologists. As a result, the final products are accurate portrayals of the various areas of psychology.

Insert Table 1 About Here

Computerized packages for research design

It is hard to determine whether students are learning very much about research design based on the computer packages developed commercially for experimental psychology. There are a lot of packages for replications of the classics in psychology; you can also find simulations. In the replications, students usually act as subjects and have little say in the construction of the experiment, although CONDUIT has marketed some flexible software. The advantages to these re-creations of the recent classics in psychology include the fact that students can get the feel for what the experimental participants actually experience, and they can get wide exposure to varied types of research, even if they don't create the studies themselves. There are also a number of simulations available. These include large, mainframe packages like FIRM (Florida Interactive Research Modules) as well as those available for microcomputers. Reactions to the simulations are often polar: some people think that they are quite useful in exposing the students to a wide range of potential research designs; others, like myself, find them fairly limiting in that they don't really capture the nature of creating an experiment, not that they are necessarily intended to.

Other types of programs are interactive in a different way. One series of programs that I wrote (entitled "Experimental Psychology" and cited in Appendix A) moves the student from passive use of the computer, merely following directions, to deciding the number and nature of stimuli for presentation, entering them and saving them to disk, and finally, running subjects. The advantage of this approach is that students are asked to do very simple things initially; when they discover that computer use may involve merely following instructions, some fear and mystery disappear; then, after a gradual buildup, they can take a more active role in using the computer. Part of my philosophy is to eliminate the trepidation that computers evoke from many students.

One novel approach to computer use in a clever way permits one to simulate not the results of an experiment, but what the researchers had to do to obtain their data. It was written by Charles Collyer of the University of Rhode Island and is noted in Appendix A. It simulates the Hubel and Wiesel single cell recording from a cat's visual cortex. The user has to shine a "light" (a geometrical shape) on a cat's "retina" (the video monitor) and then observe the increase or decrease in cell firing as a function of the position of the light on the retina (controlled through joysticks) and the shape of the probe. The presumed firing level appears as text on the bottom of the screen and changes as the user changes the location or shape of the probe. This program recreates the painstaking work of Hubel and Wiesel in determining the shape and location of receptive fields associated with a particular cortical neuron. This program is written very simply but effectively. It captures the nature of the researchers' work and still allows the user to have to puzzle through the process of trying to infer the location and orientation of inhibitory and excitatory retinal regions.

As more teachers acquire personal or departmental computers, varied individual approaches such as those mentioned here will be appearing. Of course, the students will be the primary beneficiaries. With luck and perseverance, we might be able to overcome the problem recognized by Atnip (1985), namely that for one of the classes he teaches involving "computer-assisted instruction, modeling and simulations. There was no assignment to accompany these discussions as appropriate software was not immediately available" (p. 171-172).

Statistics Programs as Teaching Tools

There is a large number of useful and easy to use packages available now. In fact, there is really no need to put up with a bad statistics package any more. Likewise, there is really no need to spend a lot of money if your statistics needs include fairly routine tests. For example, Joseph

Steinmetz of Ohio University has a very good package for Apple computers; the package is free for the cost of the disk. It has most statistical tests that students are likely to encounter in a statistics or experimental psychology course. The instructions are clear and the programs are speedy. Because the cost is so low that one need not worry that students might damage the disk.

At a slightly higher price, Human Systems Dynamics offers some packages for $100 to $300, with IBM packages being at the higher end of the price scale. It is copy protected and the purchaser receives a single archival copy. With that in mind, one might hesitate to let students use it without supervision; replacement copies are available, but you would have to wait for HSD to send it to you. In addition, it is somewhat less user friendly (and often slower) than the Steinmetz package. Nonetheless, it is a powerful package and has a graphics component.

One word of warning needs to be interjected here: Statistics packages in the public domain are available. Sometimes they are helpful, sometimes they have serious problems. For example, we have one such program that regularly produces correlation coefficients in excess of 1.00. Unfortunately, students using these packages may not realize that such values are spurious. With potential problems like the impossible correlation coefficient, one must consider when it is appropriate to use canned statistics packages with students.

Advantages. One notable benefit is that most of these programs are computationally accurate. Another is that they remove the tedium of calculations by hand or by calculator. Using the Steinmetz program, one can do a two-way repeated measures ANOVA less than 10 min. Another hidden advantage is that students can be introduced to "bigger and better" statistics if they don't have to go through the calculations by hand. For example, I have introduced my students to the analysis of covariance; they can use this option from the programs and, even though they don't know the calculations that are being performed by the computer, they can learn how to interpret the results.

Disadvantages. The other side of the coin is that before the students can use these packages, they must develop a good feel for the kinds of statistics that are available, when they are appropriate and how to interpret them. If they don't know the assumptions underlying the use of the statistics, they could well be stymied when they attempt to do the appropriate test. This problem is made more likely because most of the statistics packages are not meant to be used as teaching tools, but as research tools for the professional. Atnip (1985) has previously reviewed some aspects of the problem associated with the use of statistical packages in general. As with any tool, however, the task of the instructor is to decide when students are ready to use the computer for data analysis and then to anticipate the kinds of problems they are likely to encounter. Knowing the possible pitfalls can only come with use of the programs.

Word Processing Programs as Teaching Tools

The programs available for creating text vary as much as the statistics programs in terms of availability and ease of use. As with statistics, there is no need to use a cumbersome word processor, especially when students are going to be involved. These programs suffer from the same kinds of disadvantages as the statistics packages do: they were not designed to be used for teaching, they were designed for professional use. As a result, students can find themselves lost amid a welter of powerful capabilities in the program, but unable to use them very effectively. The result is that the computer winds up as only a very expensive typewriter. This concern has motivated me to introduce students to word processing only after they are exposed to the different uses for computers, such as data collection and statistical analysis. At this point, I hope that students are aware of different computer potentials and realize that, with some effort, word processing programs can be very helpful.

Advantages. The biggest advantage of word processors is that you can tell students to revise their papers to include new material or to reorganize their ideas. If the text is saved to disk, they can approach this task without the usual dread of retyping the entire paper. The other advantages include the cut-and-paste abilities for reorganizing ideas, global search and replace capabilities and other tasks that are major events on a standard typewriter.

Disadvantages. In addition to the possibility of creating a very expensive, poorly utilized typewriter, one drawback to using word processing programs is that the students may tie up the system for a long time. For small departments with few machines, this possibility can constrain faculty willingness to share their microcomputers with students. This problem needs to be settled with each department on an individual basis. In the Psychology Department at Thomas More College, for example, word processing is restricted to advanced students doing independent research (the other students are not instructed on how to use it and they don't approach the computer's word processing capacities); quite consistently, the advanced students create several drafts before handing in the final version. In fact, even the average student often will do this spontaneously. These students also tend to use the word processing program for any papers they are doing. I would like to reinforce the idea that even "normal" students find the computer handy for their papers once they learn how to use the program. These machines are not simply tools for the brightest people; they are a generally versatile tool.

Another consideration involves the use of programs ancillary to the word processors, like spelling checkers. The dilemma concerns the question of what we are trying to teach our students. One could argue that utility programs like spelling checkers would allow students to persist in their inability to spell. My opinion here is to let the students use the aids. After all, if spelling were that important, the students would be allowed to major in it. I prefer to spend my time with the logic of their presentations rather than the simple mechanics. I think that in the long run, the exposure to as many kinds of computer use as reasonable will make our students more sophisticated and more confident in their abilities.

Software Designed Specifically for Teaching

There is a myriad of programs available for teaching students concepts involved in psychology. Some software involves computer-assisted instruction, which I will not discuss here. I tend to avoid such programs because some of the early examples were only drill and practice techniques that seem to have been borrowed from the programmed learning style in vogue a couple of decades ago; I always found such approaches tedious and not helpful to me. The newer computer-assisted instruction has come a long way, but I still shy away from it. Part of my reaction is also based on the fact that our department does not have enough micros to allow students to schedule sessions with the computers without limiting my own access to them.

I will present two different kinds of programs that were developed to instruct students in content areas. One involves a commercially prepared program for introductory level students; the other is non-commercial and is for advanced students and designed for individual use.

PsychWorld. One innovative set of programs is the new edition of Psychworld, published by McGraw-Hill. "Operant Conditioning" and "Sleep & Dreams", are two of the fourteen in the package. Both of these involve a combination of graphics and text that are quite clever.

In "Operant Conditioning," the user shapes pecking behavior in a pigeon that hops around in a little operant chamber. The user can select manual reinforcement, FR2, continuous reinforcement or extinction; higher FR schedules can be implemented manually. Above the pecking pigeon is a standard cumulative graph of pecks and reinforcements. This program allows the student to see how shaping occurs without either the smell of an animal colony or the long conditioning times required with novices.

In "Sleep & Dreams," the user is taken to Nathaniel Kleitman's laboratory at the University of Chicago for a night of observation of sleep stages and dream reports. There is a graphic sleeper with continuous recording of EEG, EOG and EMG, along with a presentation of the sleeper's current sleep stage, plus a digital clock showing the time of night. The particular sleep stage can, as an option, be eliminated so the user can infer the particular stage of sleep. The sole negative aspect that I noted was that REM sleep is presented in the electrophysiological recordings as Stage 1, which is accurate with respect to the EEG reading, but which could be misleading to a student user. These two Psychworld programs are interesting and would probably draw a favorable response in an introductory psychology class, which is the intended audience.

Basic Electrophysiology. Beyond such commercial preparations, there is a growing number of "home grown" programs that are useful. One very compelling series of programs has been done by James Randall at the School of Medicine at Indiana University. He has constructed a series of clever programs aimed at teaching the student how nerve action potentials occur. It is a fairly sophisticated package, but advanced students should benefit from it. Figures 1 and 2, from a program called "Saltatory Conduction," depicts the change in membrane potential along the axon during neuronal firing. The user can specify the neural fiber's diameter, spacing between nodes of Ranvier, and nodal threshold; there are default values to get a "standard" picture. The flexibility in setting parameters in useful in helping the student to find out exactly why the nerve action potential is non-decremental and self-propagating. The user can also be induced to make predictions about the fate of the nerve action potential if the parameters are altered. The graphics here are very clear and the effects are compelling. The set of programs in Randall's package are all well done and could be useful in classes like physiological psychology and sensory processes. Unlike the PsychWorld programs, they are higher level and probably would not be useful in a class like introductory psychology. They are intended to be used on an individual basis, whereas some of the PsychWorld modules could be used for a large audience.

Insert Figures 1 and 2 About Here

WRITING YOUR OWN SOFTWARE

Do you want to write your own software? My own answer to this is a definitive "yes." Others, like Porter (Beins & Porter, 1985) have suggested that there are better ways to spend your time. As he pointed out, in order to create usable programs, one must devote 300 to 500 hours learning to do it. Even at that point, though, there are still many things that might be difficult to implement. For example, the computing of response times is something that any computer should be able to do very accurately. Unfortunately, if there is no built-in clock, getting the relevant data can be difficult. Fortunately, there are good programmers who have had the same problem and attempted to solve it in one way or another (e.g., Deni, 1986; Price, 1979; . Most of us will probably write our programs in BASIC, simply because it is widely used by others and it is a fairly simple language to learn (although the latter point might be debated by some who have not had much success with it). Fortunately, many solutions to problems appear in BASIC, so they are often accessible even to non-experts.

If you do attempt to write your own programs, you should heed one particular bit of advice from those who have done it already: you will need to know what you want your program to do _before_ you start writing it, or else it can get out of hand as you include one addition after another. Pretty soon, any changes you need to make are impossible because they affect other parts of the program and you can't find out which ones or where they are. In the end, you wind up with what has been called, not so affectionately, "spaghetti programming." Another element that can drive you to distraction is formatting the output either to monitor or to printer. This activity can take hours of your time. It is ironic that you can write the code for a program in a relatively short time in many cases, but trying to format it so that it looks attractive is very time consuming. One of the biggest hurdles facing nonprofessional programs involves the use of graphics. They are very hard to generate on some machines; even with utility programs designed for creation of graphics, the learning phase is tedious and difficult.

With the large number of problems facing you, you might wonder why you should bother at all. One reason is that you can customize your programs to you own specific needs, something that nobody else can probably do. Another advantage of knowing how to program is that you might be able to modify others' programs, unless of course they create their own spaghetti. One example of well-planned programming is Charles Collyer's Hubel & Wiesel program. I wanted to be able to look at the retinal field and then return to the mapping process. Because his program was written with such economy and planning, I was able to make the change without too much difficult. My knowing how to do some programming was very helpful. (I should point out that Collyer's work was remarkably clear and easy to work with; he deserves more credit for my success here than I do.) Further, a journal like _Behavioral Research Methods, Instruments and Computers_ can provide helpful hints and interesting programs. As you write your own programs, it would be wise to remember Chapanis's (1984) remark that "if computers are hard to use, if they are uncomfortable to use, or if they seem to make us work in ways that are menial or subservient, it is because some of us made them that way for others of us to use. So what seems to be a computer problem is really a people problem" (p. 217).

Finally, when it comes to writing your own programs, you should remember that no program will ever be complete. No matter how extensive you have made it, there will always be the temptation to add one more subroutine.

CONCLUSIONS

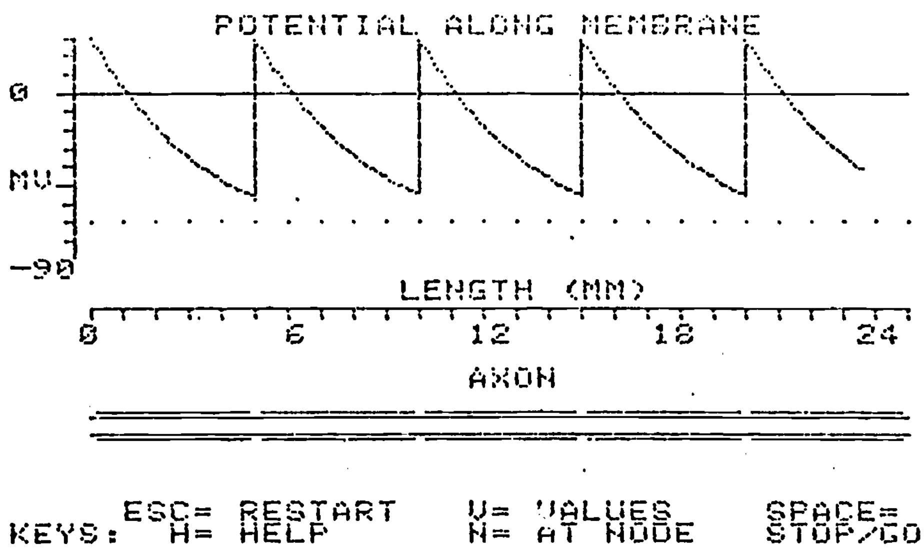
There is a lot of software out there for a large variety of applications. I am getting the impression that it is getting better because people have experienced what they don't like and are trying to avoid incorporating those things into their own software. The commercial packages like those from CONDUIT are invariably going to be well done technically and virtually bug-free, even if they are not always exactly the way you would like them to be. Beyond that, however, there are many people developing software on an individual basis; they are not marketing their software, even though the quality if extremely high. We can hope that groups like the Clearinghouse for Teaching/Learning Activities in Psychology, being organized by Joe Palladino of the University of Southern Indiana, will be able to spread the word about these computer-oriented teaching aids (as well as about other kinds of activities). You can also create your own software, which has its own advantages and limitations. It is fun to write your own, but it does take time and planning, two precious commodities.

The decision to use specific software in the classroom or for various teaching and learning processes is one that requires the instructor to assess the needs of the student as well as the quality of the software. It is increasingly true, though, that many of the different needs and wants of students can be met very nicely by the appropriate selection of hardware and software. There is reason for much optimism for using computers in teaching psychology.

Figure Captions

Fig. 1. Depiction of saltatory conduction showing electrical potential down the axon during the nerve action potential. (From "Basic Electrophysiology" by James Randall. Copyright 1984 by James E. Randall, Bloomington, IN 47405. Reprinted by permission.)

Fig. 2. Saltatory conduction showing electrical potential down the axon during an aborted nerve action potential. This example illustrates what would happen if nodal spacing, axon diameter or potential at threshold are not optimal. (From "Basic Electrophysiology" by James Randall. Copyright 1984 by James E. Randall, Bloomington, IN 47405. Reprinted by permission.)


POTENTIAL ALONG MEMBRANE
0
MV
-90
LENGTH (MM)
0
6
12
18
24
AXON
ESC= RESTART
KEYS: H= HELP
V= VALUES
N= AT NODE
SPACE=
STOP/GO

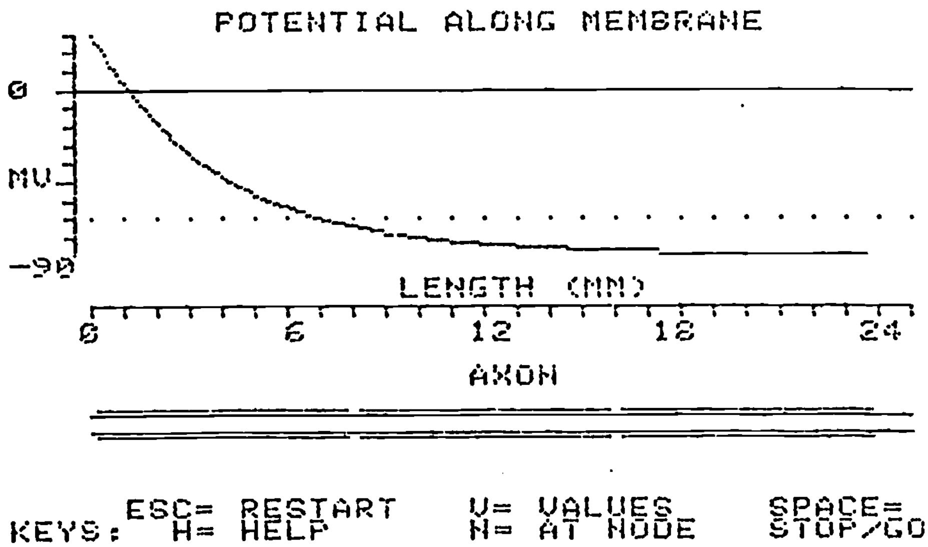

POTENTIAL ALONG MEMBRANE
0
MV
-90
LENGTH (MM)
0
6
12
18
24
AXON
KEYS: ESC= RESTART H= HELP
V= VALUES N= AT NODE
SPACE= STOP/GO

Table 1. Partial listing of areas of psychology for which software has been developed by individuals for their own use. (Titles are merely descriptive; more information appears in Appendix A.)

	Area of Interest	Available Software
1.	Social Psychology	Conformity; Social Cognition
2.	Perception	Unknown Process Analysis
		Phi Motion; Lire Generation
3.	Educational Psychology	Russian Mnemonics
4.	Cognition	Word Categorization
		Analysis of Self
5.	Personality	Self-Assessment
6.	Learning	Memory for Word Pairs
		Word Frequency

1. This paper is based on an invited presentation made at the Second Annual M -America Conference for Teachers of Psychology, October 18-19, 1985. Evansville, IN.

2. Requests for reprints should be sent to Bernard C. Beins, Department of Psychology, Ithaca College, Ithaca, New York 14850.

References

Atnip, G. W. (1985). Teaching the use of computers: A case study. Teaching of Psychology, 12, 171-172.

Beins, B. C. & Porter, J. W. (1985, October). Computers I: A BASIC introduction. Paper presented at the Second Annual Mid America Conference for Teachers of Psychology. Evansville, Indiana.

Boice, R. (1982). Teaching of writing in psychology: A review of sources. Teaching of Psychology, 9, 143-147.

Chapanis, A. (1984). Taming and civilizing computers. In H. Pagels (Ed.), Computer Culture: The scientific, intellectual and social impact of the Computer. Annals of the New York Academy of Sciences (Vol. 426). New York: New York Academy of Sciences.

Collyer, C. E. (1984). Using computers in the teaching of psychology: Five things that seem to work. Teaching of Psychology, 11, 206-209.

Costin, F. (1982). Some thoughts on general education and the teaching of undergraduate psychology. Teaching of Psychology, 9, 26-28.

Deni, R. (1986). Programming microcomputers for psychology experiments. Belmont, CA: Wadsworth.

Grabe, M., Petros, T. & Mann, S. (1984). Development of computer-controlled study management systems. Teaching of Psychology, 11, 179-181.

Ha,, J. C. (1985). PsychWorld (Computer program). New York: McGraw Hill.

Klugh, H. E. (1983). Writing and speaking skills can be taught in psychology classes. Teaching of Psychology, 10, 170-171.

Lancaster, D. (1985, August). Ask the Guru. Computer Shopper, pp. 43, 93, 95-97, 100, 105-106, 108-109, 150-152.

Lupo, J. V. & Ware, M. E. (1984). Continuing education in micro-computers for academic and practicing psychologists. Teaching of Psychology, 11, 40-41.

Makosky, V. P. (1985). Teaching psychology in the information age. Teaching of Psychology, 12, 23-26.

Norman, D. A. (1984). Worsening the knowledge gap: The mystique of computation builds unnecessary barriers. In H. Pagels (ed.), Computer Culture: The scientific, intellectual and social impact of the computer. Annals of the New York Academy of Sciences (Vol. 426). New York: New York Academy of Sciences.

Pettijohn, T. F. (1985). Development of a computer tutoring and testing program for the general psychology course. Teaching of Psychology, 12, 103.

Price, J. M. (1979). Software timing for 6500 series microcomputers. Behavior Research Methods and Instrumentation, 11, 568-571.

Swenson, E. v. (1982). Faculty adaptation to changes un undergraduate psychology education during the eighties. Teaching of Psychology, 9, 59-62.

APPENDIX A: Brief description of some of the programs written as teaching tools. (Some of these packages are available only for Apple systems although related programs are also available on IBM computers in many cases.)

Author	System	Programs
B.C. Beins Thomas More College	Apple	Experimental Package (Perception/Psychophysics; Verbal Learning; Cognition; Educational Psychology)
C.E. Collyer Univ. Rhode Island	Apple	Experimental Package (Perception/Psychophhsics; Hypothesis Testing; Hubel and Wiesel simulation)
McGraw-Hill	Apple IBM	PsychWorld (Set of 14 programs at introductory level for first level psychology classes)
J. Mueller Univ. Missouri	Apple	Social Cognition/Cognitive Psychology (Judgment of personality; memory tasks; speeded response tasks)
J. W. Porter Thomas More College	Apple	Correlation; Conformity (Performs correlation and graphic display; Asch-type conformity task with a ratio scale task)
J.E. Randall Indiana Univ.	Apple IBM	Basic Electrophysiology (Series of programs dealing with the nerve action potential, ion flow, membrane potentials, saltatory conduction)
S.A. Schwartz Nibble magazine	Apple	Pearson Product-Moment Correlation (Allows computation of correlations among several with ratio scale response)
J. Steinmetz	Apple	Statistics (Fairly complete set of common statistical tests; self-documenting in general)