Computer Center

More on The Development of Good Instructional Software

James D. Spain
Department Editor

The article "Why Isn't There More Good Instructional Software" [Spain, J. (1985, September). *American Biology Teacher*, 47,(6), 237] stimulated more than the usual response from our readers. One of the letters included some comments that I believe would be useful to both users and developers of instructional software. They came from Stephen Klein, a biology teacher at Shenendehowa Central School, Clifton Park, New York. Steve and programmer Jim Vogan have recently published a program "Microscopic Measurement" through Intellectual Software (798 North Ave., Bridgeport, CT 06606). Here are his comments:

"The Evolutionary Approach Versus the Top-Down Approach of Software Development"

"These two approaches to educational software development appear at first to be at opposite ends of the spectrum. The evolutionary approach does not necessarily require a polished product as its goal, while the instructional design team effort has as its goal a commercial product. However, like many other things, the development of biological software actually lies somewhere in between these extremes. The evolutionary approach has some pre-conceived goal in mind and the design of the program is thus tailored to fit that goal. The instructional design methodology, no matter how detailed the top-down or bottom-up design plan, must have built into it certain stages for formative evaluation in which students and/or peers react to the progress to date. The design plan is then modified. The more sophisticated the objective, the more a careful instructional design plan is needed.

"In the design of programs that rely heavily on text and/or number crunching, an individual often can function as the sole author. This person would have to possess knowledge of the biological content, educational theory and programming in a language such as BASIC. As software evolves to match the capacities of the hardware in such features as animation, use of high resolution graphics, sophisticated branching options and greater interaction between user and machine, the need for specialists in a team approach grows. The position of programmer must be upgraded to include programming in higher level languages. The length of the project suggests the need for a developer/producer skilled in the programming of educational software for publication. This person should also be skilled in communicating his/her ideas to educational publishers. The increase in sophistication of the software also warrants an improvement in the documentation development procedure. This may be beyond the time or training of a solo author and may necessitate a technical writer.

"The design team thus must bring together five separate elements: a biological idea worthy of computerization, expertise in instructional design, advanced programming skills, experience in production and communication and technical writing. The chances of combining all these elements in a single individual decrease with the increase in the number of elements. As pointed out in the *ABT* article (Spain 1985), an increase in specialization brings with it an increase in communication problems among the individuals of the team. Since several of the roles may be carried by an individual, the optimal team size is somewhere between one and five individuals.

Communicating with Publishers

"Successful communication is indeed an art. It is difficult to generalize as to the type and nature of responses, but it is safe to say that for every 10 letters sent out by an aspiring software author, less than 10 responses will return. If you are an author, you must try to target your publisher in advance and present to perspective publishers a brief summary on your project.

"Finding the right publisher is no easy matter. Texts showing lists of education publishers and their type of product do exist, but they are quickly outdated. If you are a biology educator, the easiest way to determine which publishers are reaching the buying market is to keep a file of incoming software catalogs. These catalogs should help you determine the educational level at which the software is being marketed and whether or not the publisher solicits new software. It is also to your advantage to determine the software review procedures of each publisher. This information will give you an idea of the level of support from the publisher and the time frame under which review occurs. This information is rarely given in catalogs and must be obtained by writing directly to the publishers.

"Now that you have compiled a target list, it is necessary to deal with the issues of what to send and when to send it. If considerable instructional

This is **Jim Spain's** last column as Computer Center Department editor for the *American Biology Teacher*. We bid him farewell and thank him for two years of stimulating computer-oriented articles. Jim is an educational consultant specializing in college level science courseware development and utilization. After retiring from the Biological Sciences Department at Michigan Technological Univ. where he taught for 22 years, Jim moved to Eastern Michigan Univ. and then to Clemson University's Chemistry Department, where he is currently working.

Beginning with the September issue of the *American Biology Teacher*, the editor of this department will be **Richard Duhrkopf** of the Biology Department at Baylor University, Waco, TX 76798.

design has been done, contacting the publisher could begin at the start of the project. The deeper you get into the project and the more time you invest before contacting publishers, the more you could waste your efforts. As soon as you have a working disk based on some feedback from students, you should definitely start contacting publishers if you have not done so already.

"Sending the entire design plan to the publisher may be an overkill. The publisher may get many such proposals and be interested essentially in a synopsis of what the software is and why it is being produced. To fill this need, the author could in addition to writing a summary of the design plan prepare a rationale page on why this piece of software is needed and a specifications page stating the technical aspects of the project.

"If you are not at all in a hurry, you might try sending off your proposal to a single publisher that fits your selection criteria. If however, you want to get on with the project, you may decide to write several publishers at once and compare the responses. Selecting a publisher that meets your needs and not merely theirs is very important. If your software product has not gone through several levels of evaluation already, then selecting a publisher with a strong review procedure becomes more important. Remember that making sure the incentives to complete the project remain intact is your duty, not that of the educational software publisher.

Evaluating Economic Incentives

"The current industry standard is that the software author gets about 15 percent of gross sales revenue. If some disks are sold to jobbers at a reduced rate, then the dollar return to the author per disk decreases. Spain (1985) calculates that for a project that takes 1000 hours (and good ones do), the rate of return to the author is about $1.50/hour. This is further reduced if several members of a team divide the royalties obtained. The apparent lack of financial return may be enough to discourage aspiring authors. However, the future may not be so bleak.

"Authors can maximize their rewards by building in courseware flexibility at the initial instructional design stage. Many biological topics are inherently taught at both the secondary level and at the collegiate level. It is only the level of presentation that changes with the audience. Selecting topics that can be offered at both levels will greatly increase the potential market for an author. If the topic can be presented in sequential levels of difficulty and still effectively use the microcomputer to its potential, then marketing it for both audiences becomes pragmatic. The determination of the sequentiation for the presentation of topics and the manner of presenting only the proper topic levels to the target audience should be built into the instructional design. These options could be given to the students in the form of a menu or alternatively preselected by the teacher as part of a management system.

"An independent software author must rely on the publisher for disk duplication, protection against copying, catalog production, marketing and product distribution. In some cases, documentation may be done by the publishing staff. However as the size and sopistication of the software grows, this responsibility is shifted to the technical writer or instructional developer of the design team. In this case, perhaps the splitting of the royalties should reflect the evolution of responsibilities, with more than 15 percent going to the software design team.

"Once your software has been published, your options have been greatly reduced. In some cases, good software could sit in a catalog awaiting chance discovery. Placing software for review in the proper periodicals, featuring it at large conferences and placing classified ads should all be the responsibility of the publisher. These are costly for the publisher, so knowing the recent track record of the publisher is advisable before you sign any publication agreement. The software author should not suffice in knowing the work is published, but should make every effort to maximize the exposure of those products that bear considerable effort and worth to the field of biological education."

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Editor's Comments

Several good points came through to me as I read Steve's comments. Some he made directly and others were implied by what he said.

1. Any instructional software development project must identify educational objectives and set about to meet these in the most efficient way possible.
2. Successful courseware authors must plan ahead to ensure that they become associated with a software publisher that will maximize the exposure of the resulting product.
3. Courseware authors can maximize their financial return in several ways:
   a. by designing courseware for a broad student market;
   b. by associating with effective publishers with a good track record;
   c. by planning courseware in such a way as to shorten production time; and
   d. by minimizing the number of people on the production team.

If all aspiring courseware authors went into a project with these ideas clearly in mind, I believe more projects would make it all the way through to the final publication stage where the courseware could become useful to the field of biological education.

More on the Problem from Another Source

The following comments are taken from an article "What's in the Educational Software Pool?" appearing in *MICROgram* Vol. 3, No. 7, 1985, a publication of the Educational Products Information Exchange (EPIE), P.O. Box 839, Watermill, NY 11976. They are included here with the permission of EPIE because of their relevancy to the ongoing discussion of instructional software quantity and quality.

"An Analysis of What's in the Educational Software Pool

"At 7,700 programs and counting, is the educational software market reaching saturation? It might seem that with so many programs already available, educators would have a more than adequate pool of software from which to draw any kind of program they need. And it might seem that more than eight years after the introduction of microcomputers in education, the programs joining the pool would be state-of-the-art——comparable in quality to those that revolutionize business systems every six months.

"Yet in a paper delivered at the recent American Educational Research Association meeting, Robert Haven, Director of EPIE's TESS database of educational software, draws just the opposite conclusions:

1. Far from all of the programs needed having been produced, less that half of what would be desirable is available.
2. Rather than taking advantage of the unique, powerful capabilities of microcomputers to implement new, more effective pedagogy, most commercial software efforts are mired in the timeworn approaches rooted in the limitations of the old media.
3. Rather than reaching levels of excellence, overall software quality improved through 1982 but then leveled off on a plateau best described as barely adequate (while a modest number of excellent products is available, they are the exception).

"In summary, the educational software field, although having great potential for improving education,. . . has a lot of growing to do.

"Haven's conclusions are drawn from analysis of the TESS database of 6,126 commerical programs intended primarily for education and from a subset of 2,757 programs issued with copyright dates.

"Haven reports a preponderance of high structure/low learner control software (such as tutorials) and anticipates an even higher proportion in the future. He projects that the proportion of programs with drill and practice, game, data retrieval and computational tool components will hold steady at their current levels. Tutorial programs will increase, and simulation programs will decrease. For educators who had hoped educational computing would take advantage of learning methodologies that offer an alternative to those traditional in print-based media, the increase in tutorial programs and the decrease in simulations is bad news."

Editor's Comments

Haven's reports makes it more and more evident that the expense of producing high quality software will continue to discourage its development unless we solve some of the problems cited in the earlier article (Spain 1985) and in the discussion above.

Labs

Who Needs Labs in Biology?

Don Igelsrud
Department Editor

Let's face it, labs are a lot of trouble for everyone. You put in hours of extra effort preparing for them and half of the time they don't work. The students don't read the directions, the materials aren't reliable or don't arrive on time, and the costs are getting out of sight. If you need help, nobody seems to know the answers, they're never in the textbooks or manuals, and no one cares if you put in the extra time. We would eliminate a lot of headaches if we eliminated labs.

Welcome to a new *ABT* department! Over the years, and especially in the early ones, ABT has published many fine articles that have helped biology teachers in the laboratory. However, because many biology teachers lack laboratory experience due to the reduction in lab courses at colleges and universities, much of what we've learned about lab teaching has been forgotten. The current interest in computer assisted learning and in teaching the methods of science has put lab teaching on the back burner. The problems indicated in the beginning of this column have caused many people to turn the burner off completely. To quote Bill Leonard (ABT 43: 445): "Laboratory instruction is on trial!"

Many of us strongly believe that biology and the lab are an undivorceable marriage—if you don't have a lab you can't teach biology. In order to understand what it means to be alive, you must become intimately involved with living things. The purpose of this new department will be to help biology teachers understand and solve the problems they confront in the broadest sense of the word "labs."

Saving Time

Bruce Oakley and Rollie Schafer, in their model laboratory manual *Experimental Neurobiology* (The University of Michigan Press 1978), state, "Laboratories are a notorious time sink." More communication among biology teachers about the problems of laboratory teaching can greatly improve this situation. I spent many of my early years in teaching trying to get the basic experiments in biology to work. I assumed the problem was with me or the students and not with the experiments. As I began to talk with colleagues at other universities and colleges and with scientists working in the field, I discovered that the problem was with the experiments.

In the late 1970s I initiated the formation of The Association for Biology Laboratory Education (ABLE) in order to develop communication among laboratory biology teachers at undergraduate institutions. This organization, primarily through its annual workshop/conference and proceedings has done much to improve laboratory instruction at the post secondary level. However, even at the university level, time restrictions have forced ABLE members to restrict their communication to the annual meeting. Needless to say, time imposes even more restrictions on teachers at the precollege level.

Therefore, I would like to use this column to develop discussion and cooperation among biology teachers about lab problems. By addressing your major problems we may be able to give you more time to help others solve theirs. I can begin this column by addressing the questions I believe to be the major ones facing biology lab teachers; however, since everyone has a different perception of what those problems are, it would be better if you submitted questions and I tried to find the best answers to them. Undoubtedly, many of you have found excellent solutions to many of these problems and we could alert others to them via this column. Most of you probably have many little tricks to the trade you've learned that don't merit an article in ABT, but if you send me a note, I can group them together under various topics as they are discussed and communicate them to your colleagues. In short, here is an easy way for you to help solve many of the practical problems of lab teaching. Remember, a quick, simple note