Technological Advances in Agricultural Economics Curricula

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Abstract

The potential use of computers and electronic technology have created considerable interest among educators in agricultural economics. This paper provides an overview of the use of electronic technology within agricultural economics curricula; examines areas in which technological development offers promise and examines issues associated with adoption of the technology.

Key words: agricultural economics curricula, computers, multimedia, technological adoption.

Introduction

Computers and other instructional technology have long been heralded as change agents in our educational system (Kearsley, *et al.*) and there have been many impressive demonstrations over the years. Some, however, argue that no form of technology since the chalkboard has really created a fundamental change in schools and that technology has not lived up to its potential to improve learning for most students. This dismal view appears to be changing as teachers learn how to use computers as an integral part of classroom activities rather than strictly as a learning aid (Kearsley, *et al.*).

Callister suggests that the current computer revolution is failing and suggests that we must capitalize on and learn from the reasons for this failure. He suggests that there was a fascination with computerizing the old curriculum so that it could be delivered more quickly and efficiently and that there was a mind set that viewed technique as the centerpiece of good educational practice. Bowers argues educators must reject the prevailing modern myth that technical progress is necessarily positive and realize that instructional uses of computers are often accompanied by detrimental side effects.

Chin and Hortin report that many K-12 teachers are still skeptical of the value computers have in education. It is interesting, however, to note that while the lower level educators are still uncertain of the value of computers in education, higher education has lagged behind primary and secondary education in incorporating multimedia into both teaching and learning (Sammons). In both cases, technology with all it promises, appears to have detractors or limitations which have limited its use for educational purposes.

The objectives of this paper are to provide an overview of the use of technology within the agricultural economics curricula, to examine areas in which technological development provides real promise, to examine the issues associated with adoption of the technology, and to challenge the profession in evaluating the effectiveness of computers to enhance students' learning.

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J Agr and Applied Econ. 27 (1), July, 1995: 86-94

Overview of Technology Use in the Curricula

There are various forms of technology and many different uses for electronic technology in education. Obviously, computers play a major role in the technology discussed in this paper, but electronics in general also provide many new and exciting opportunities to enhance the educational process. Ruppel provides a balanced view of alternative teaching media indicating a list of positives and a longer list of negatives regarding computerized projection equipment in the classroom.

In this paper, we will divide the uses of electronic technology into three categories to facilitate discussion even though we run the risk of overlooking some potential uses for technology in education. The next three sections outline the potential use in three areas of education.

Outside Class

Data Analysis

Using the computer for analysis purposes tends to generate a lot of enthusiasm on the part of faculty. Denk, Martin and Sarangarm found in their survey of faculty that the largest usage of the computer is not in the classroom, but in requirements for assignments outside of the classroom. In agricultural economics, with its analytical orientation, the implication is that using computers for analysis is likely one of the most exciting opportunities.

Initially, main frame computers were used for statistical analysis (SAS, SPSS, and others) and linear programming. Now, the sophistication of spreadsheet programs and statistical programs on personal computers is quite phenomenal from a computational standpoint. The availability of sophisticated search routines to find solutions in complex spreadsheet constructions provides students with analytical capabilities only dreamed of only a few years ago. Not only are search routines valuable when solving for a predetermined target value of interest, such as a breakeven point, sophisticated optimization routines allow solution of maximization and minimization problems with surprising ease. Regression analysis can easily be performed on a personal computer and the extensive graphing options allow students to develop data analysis skills they will be able to use on the job. The scenario managers and complex mathematical and financial functions provide analytical potential which makes an oldtimer salivate. These tools in the hands of talented students with solid economic training provide tremendous potential.

Computers allow students to solve complex real world problems they will face once they leave the university environment. In the past, the complexity of some problems had to be reduced to such a great extent in order to be solved with a calculator that they became little more than "textbook" problems. Such extensive simplification is no longer necessary because the computer can handle much more difficult problems and, as a result, the analytical tools being taught should be useful when the student graduates.

Use of computers for analysis purposes has the potential to separate the better students from poorer students. The academically strong students will adapt and excel at integrating the computer with concepts of economics in a powerful synergism that will truly be beneficial. For poorer students, especially those uncomfortable with a computer, computer technology is another layer of complexity they cannot reach through to understand even the concept. Thus, they will fall even farther behind the good students.

Simulations and Games

Motivational and experiential aspects of technology in education need to be captured and used to advantage. Computerized games used outside the classroom, in class, or in computer-aided instruction settings can be used to motivate students. The natural competitiveness of students can be a powerful motivator to stimulate learning. Likewise, experiential learning in a game setting can be a powerful tool for teaching. Computerization that capitalizes on these aspects can be very effective in enhancing learning. Kenkel reports that using an agribusiness simulation game had observable positive impact in terms of student morale and interaction.

There are also a number of simulations and games which have generated a great deal of enthusiasm from educators. Park, Gray, English and Cleland report very successful uses of the

Green Revolution simulator, while Thunberg describes the successful use of a game which demonstrates natural resource and common property problems. Koontz, Peel, Trapp and Ward report very successful use of the Fed Cattle Market Simulator, and White describes a game used to teach agricultural trade. Farm management games associated with Taylor and Kadlec have been successfully used for many years. There is, in general, great enthusiasm for the use of games to make the material come alive.

Computer-Aided Instruction

There is great potential here for instructional packages which have tutorial and repetitive characteristics.. Livergood found that a multimedia format with the addition of an interactive tutor system which tested and reviewed materials as needed did enhance learning.

Walbert suggests that the majority of software packages are pedogically naive and mundane and are little more than turning electronic pages. He states that in order to produce high quality software to teach principles of economics courses, students need to be involved with the software and they must get immediate feedback. There should be an increasing level of difficulty. There must be high quality graphical models and the material needs to be integrated with the text or lectures. Nelson and Seitz report that they have been able to achieve many of the goals set out by Walbert and they report on how some of the design issues were addressed. Nelson and Seitz very nicely identify one of four learning styles to which their software approach is likely to be appealing. They caution, however, that software development is still an expensive process in time and money.

These projects are enormous undertakings which require updating, modifications and a support network if they are to be marketed over a variety of situations. In addition, the interactive nature and the tutorial aspects require insight into the difficulties students have in learning the concepts. These insights come only at the great expense of extensive experience and thus should not be undertaken by beginning teachers.

It is possible to dream of the potential for these systems to identify the elements of the economic concepts that students are lacking and to fill in those missing links so that students fully comprehend the concept, but we may be dreaming a little with regards to the reality of such systems. Such systems are possible, but only at great cost which is why there still remains only a great potential in these systems. Over time, the potential may remain rather than the realization of such potential.

Information Super Highway

It is possible for the internet to make both good and bad contributions to education. Bulletin board study groups offer interesting positive potential, but also carries with it the possibility for negative contributions. The opportunity to freeload off of others (we used to use the word cheat) and the potential to get term papers on virtually any subject offer very enticing shortcuts to learning and these will likely be tried. Monitoring this type of activity will be next to impossible.

One very interesting possibility for educational use of technology is the use of classrooms set up for electronic brainstorming. Gallupe and Cooper report on the use of electronic brainstorming to generate an abundance of ideas anonymously. Incorporating this type of activity into the case study approach in agribusiness or other appropriate settings has a great deal of appeal. Gallupe and Cooper report that electronic brainstorming is a technological update of traditional brainstorming that eliminates many of the problems that have plagued traditional face-to-face brainstorming. This technique has great appeal as a teaching tool.

In-class

There are a variety of uses of technology and computers in the classroom. Demonstrations, electronic overheads and multimedia presentations are a few of the ways in which electronic technology can potentially enhance the educational process. Denk *et al.* conclude that computers have not been integrated into the classroom as much as one would expect. There are several reasons for this, but great potential has yet to be realized.

Electronic Overheads

Electronic overheads were among the first uses of electronic technology in the classroom. Initially, the graphics software allowed faculty to generate good looking transparencies. As technology advanced, these overheads evolved from transparencies to computer-generated overheads. Debertin and Goetz report that graphics have been successfully used in agricultural economics courses and that the faculty in large measure believe that the cost of equipment has been well worth it.

Computer-generated overheads allow the use of multiple colors and revealing presentations, the development of complicated graphs and the ability to jump from one slide to another. In addition, it has the advantage of allowing students to purchase copies of overheads used in class; however, this form of presentation requires detailed planning and organization on the part of the faculty.

There are disadvantages associated with this form of presentation. One disadvantage, one also associated with the lecture form of presentation, is that students have more opportunity to become passive learners. This disadvantage is exacerbated because frequently the presentation equipment requires a darkened room.

One of the requirements for successful presentations is that the technology must be high quality so that the presentation is visually captivating without distracting the audience. There are two physical components to a successful visual presentation. It is essential that ambient light be controlled in some fashion so that it does not interfere with the projection system. Care must be exercised to make images readable in terms of size and contrast. These factors are not currently insignificant since the ability of current projection equipment to produce enough light and resolution quality is sometimes stretched in large well-lit rooms. LCD panels, LCD projectors and RGB graphics projectors are improving with each new model, but some are still stretched in their capability to handle some situations.

Multimedia

True multimedia presentation allows the incorporation of videos, CD Rom, laser discs and sound equipment in the presentation. The authoring software available on the market easily allows reasonably computer literate faculty to incorporate as much, or as little, of the available media into their presentations as they want.

The advantages and disadvantages associated with multimedia presentations are very similar to those associated with electronic overheads. In addition, it is essential to have high quality audio so that it does not distract from the presentation. One big advantage of using this software is that it greatly facilitates leaving the linear form of presentation. Hyperlinks can be created from a base page to a large amount of supporting information. This form of presentation requires more organization and preparation than the electronic overheads (DeFelice and Monson).

Distance Learning

Distance learning through the use of video transfer has advantages and disadvantages over the typical classroom arrangement. There is greater logistical flexibility since not all students have to be in the same location at the same time. Class sizes then can be quite large since many locations can be used to handle large numbers of students. In addition, distance learning can expand the resources of departments since they will be able to offer courses in areas in which they have few or no faculty.

The disadvantages are that this method of teaching when provided by video recording is unidirectional and non-interactive. If distance learning courses are presented live, there is some feedback potential over the phone, however, it tends to be awkward at best. Live presentations also have to address problems of restrictive scheduling. Live presentations of distance learning courses requires considerably more support equipment and personnel than live performances in a single classroom.

There are also logistical difficulties in terms of distributing materials and additional requirements are placed on the distance sites. Multimedia presentations and video transfer for distance learning are both limited currently due to the technological problem of transferring staggering amounts of data for the real time display of video and multimedia presentations. The sites are also

expensive by some standards. Finally, there may be a lack of peer to peer interaction which can also facilitate learning. The internet and other forms of networks, or even cable television, may begin to be used for this purpose once the development of increased transmission rates eventually meet the needs for remote learning. Technological improvements will overcome these problems at some point in the near future and a tremendously expanded capability will be made available to the masses, not just the select few with grants for demonstration purposes.

When remote learning becomes cheaper and more feasible in technology terms, the use of remote learning has the potential explode. At this point, those poised to take advantage of the vast opportunities made available with the expanded ability to transfer vast amounts of data will likely leave the rest of us behind. The first innovators to teach and broadcast over wide areas successfully will capture a large share of the education business. They will become the regional or, in some cases, national dispensaries of programming, while many others will be relegated to the also-ran category which may be asked to deliver the notes or other materials which cannot be "handed" out over the optical fiber network.

There are certainly ranges of qualities of live instruction as well as of qualities of video (talking heads) performances, and these ranges result in "distributions." There likely is already some overlap of these distributions in terms of instructional quality. The best videos are likely better than the worst live presentations and it is likely that over time, the lower tail of the distribution of live performances and the upper tail of the distribution of video presentations will overlap to a greater extent. This suggests that video will begin to creep into the educational environment of some institutions as replacements for their live performances; however, it is unlikely video will serve as total replacements because of the motivational aspects and personal touch that exist in live performances.

One of the major hurdles to the mass distribution of quality distance learning is the difficulty currently of capturing the rents associated with the value of the programming. Turf battles are abundant regarding the capture of student credit hours. The public good nature of the programming lends itself to benefiting society, but barriers to adoption exist because of the rent capture issue. Government or administrators at levels higher than academic institutions must be called upon to mediate and resolve these issues to pave the way for widespread adoption of distance learning.

Technology in Textbooks

There are very interesting possibilities when we consider the use of technology for generating classroom materials. The generation of textbooks tailored to specific classes is here and will likely expand. The use of electronic versions of classroom materials, such as CD-rom books, and the distribution of material over networks should be explored for their potential to enhance instruction and possibly even lower costs.

We frequently hear about the potential for information exchange with the use of the internet, and we need to be careful to not miss out on opportunities to enhance educational material distribution with new technology.

Concerns Regarding Classroom Adoption

Impact on Learning

Throughout all the discussion of the great potential for computer-enhanced learning, a potential exists for much of the effort to be devoted in this direction simply because it is new, innovative or novel. In all of the efforts to select innovative teaching approaches, we must keep in mind that the objective of education should be to bring about learning on the part of the student, to instill a desire to learn, and to leave them with an appreciative attitude toward the subject.

Customers' needs are the focal point of businesses. When their needs change, businesses need to adapt to the changing environment. Unfortunately, student needs seem to have changed; they have become much more visually oriented and less inclined to read. Orientation toward TV and video games may have led to these changes. If students have changed this way, then we need to consider teaching approaches which accommodate these changes.

One of the greatest benefits of the myriad of technologies that will become available in the classroom is the opportunities they afford for greater variety in the classroom. There is great benefit to infusing "controlled variety" into the classroom. By controlled variety, we mean variety under control, not rampant, disjointed and flagrant to the point of distraction. With a "Young and Restless" generation nurtured on short soundbites, variety is more than welcome, it is almost a necessity to maintain interest level.

Use of any technique solely for entertainment value is a distasteful topic. The irritating aspect of entertainment in the classroom is the fact that it seems to be a desired aspect of the class from the student point of view, even if it is not used to enhance learning. Educators who have never been joke tellers recognize that entertaining examples can be very effective in making points and illustrating principles. The concern we have is that video may be used by some strictly for the entertainment value, or the show, and not because it enhances learning. A continuous diet of this might get old, but some will certainly be a welcome addition to the variety of the classroom.

In all of our efforts, the classroom objective is not to produce passive video potatoes; however, this may potentially be what is encouraged in some instances. We need to keep the objectives of education always in the forefront: to produce active problem solvers and lifelong learners. The process of achieving these objectives spans different levels of cognition (Bloom; McKeachie; Wilson and Morren) and for some levels the use of computers will excel and for others the technology must be used with caution. According to the Bloom taxonomy, cognitive scale, students must acquire knowledge of a subject, the ability to recall, to name and to list the concepts. In this area, electronic technology with its repetitive nature offers tremendous potential. In the next phase on the cognitive scale, students gain the ability to comprehend and use ideas. This level of cognition must use computers with caution. Then when students reach the level of application where they gain the ability to apply concepts in different contexts, computers offer great potential. The spreadsheets, simulations and games can be effective learning tools. When students are faced with analyzing and synthesizing problems, computers should only serve as tools to facilitate the computational aspects of analysis. In the final level of cognition, students must learn to evaluate. They must gain the ability to make judgments and reach conclusions. At this level, students cannot rely upon the computer to provide answers. It is imperative that they learn to question results and integrate concepts to reach a conclusion.

Problems Associated with Adoption

It is essential that technology not limit what we do in the classroom. Technological innovations must be selected and used only if they provide additional capabilities. They must not force us to apply technology to a problem in such a fashion that it constrains our content, approach or ability to teach the concepts of the profession. We cannot apply technology and not change anything else about the course or the method of instruction, nor can we expect technology to be best at doing everything. We need to evaluate where technology will improve learning. Callister suggests that we need to start with the understanding that technology must be subservient to the educational questions it is employed to answer. Some of us need to take some risks to explore the potential for technology and to develop pilot programs where promise is identified.

A computer science education carries with it a strong dose of the attitude that the computer can do anything and should be used for everything. To a surprising degree, the first part of the previous statement is correct, computers can do a great deal. An agricultural economics education carries with it an enormous dose of marginal analysis and the concept that benefits must exceed costs in order for a plan to be acceptable. This concept of benefit/cost comparisons is frequently disregarded when evaluating computer technology. The benefits are extolled *ad nauseam*, but the costs are frequently disregarded. That would have been totally acceptable in computer science, but it is inexcusable in the field of agricultural economics. Dahlgran suggests a model which can be used for purposes of cost benefit analysis and learning achievement analysis. We need to very clearly recognize the costs associated with new technological methods of teaching. Novel first time

attempts and pilot programs are frequently funded by grants, and the efforts receive considerable attention. However, before recommendations for adoption for mass applications, the costs, in time as well as monetary terms, need to be clearly spelled out and compared to the benefits.

The profession must recognize that it will take support and sustained funding for adoption of electronic technology to take place. In the past, application of the technology has been innovative and novel and there has been grant funding to develop applications. This will probably not continue in the future, and without sustained funding, we will become outdated. Not only will support have to be provided for software, hardware and classroom facilities, it will have to be provided for the development of the application and within the faculty reward system (DeFelice and Monson).

Computers and technology have some unique characteristics which seem to discourage use and these characteristics result in intimidation among people and inefficient use of time. Basically (and simplistically), if one knows how to perform an operation on the computer, that operation is simple to them. If one does not know how, or has not experienced doing this operation on the computer, the operation is (nearly) impossible to do. Now, there are trial and error stumbles that lead to the correct procedure but this is hardly an efficient process. While software has been improved substantially in recent years to the point where one can experiment trying things and sometimes find the correct procedure, there is still this simple/impossible dichotomy lurking in the shadows. This characteristic also leads to damaged egos very easily. Someone who knows how to do a procedure thinks the procedure is simple and can very easily unintentionally put down someone who is struggling with the procedure and thinks it is impossible. Addressing this sensitive issue in a constructive manner so that people are not insulted or intimidated is important to facilitating instruction when computers or technology are involved.

Jalbert suggested that technophobia was a problem of the faculty. Hooking up the required equipment (if you are not blessed with a permanently installed system) and getting it to work can be stressful with an audience watching. Software glitches or hardware hiccups become embarrassing and credibility destroying events of seemingly major proportion which can detract in a major way from the educational objectives of the lecture.

Summary and Conclusions

The profession should look forward to changes about to unfold in the near future. There will, as always, be winners and losers, but the potential for more efficient use of outstanding educators and the societal benefits of a more educated and capable citizenry are something to get excited about. Nonetheless, we must overcome several obstacles in order to achieve these exciting prospects. As a profession, we may need training in how to be an acceptable if not outstanding "talking head" on videos. First adopters of technology will be enormous beneficiaries of the economies of size aspects of the technology. The enormous fixed costs and the relatively small variable costs of distribution of programs will to a large extent exclude everyone from following the lead of the first successful innovators with regard to using technology for educational purposes. The technology innovations will not go away, but instead will multiply like rabbits to the point of being nearly overwhelmed by the opportunities and possibilities. There will be enormous possibilities for adding variety that will help some learn, reinforce the learning of others and entertain some. The motivational aspects of games in an interactive environment should be harnessed and used for all they are worth.

Agricultural economists have reached the point where it is time to test the benefits of the technological innovations in teaching. Ideally, we should test with control groups the increased learning efficiency which technology allows. We need to set up experiments to estimate the impacts of different approaches to the educational process. Some studies of this nature have been completed but the results do not agree. For example, Livergood found that simply transferring material from hard copy to a multimedia format did not enhance learning of the material. However, the multimedia format with the addition of an interactive tutor system that tested and reviewed materials as needed did enhance learning of the material.

Distance learning opens us up to the outside world and may make us more accountable to the public. We will need to deliver relevant timely material because this will be more like a marketplace with a much less captive audience. The audience may switch back to Sesame Street if we are not producing what they feel is beneficial.

Technology may allow us to tailor educational efforts to individuals needs. Self-paced, individualized learning may have great potential and machines have considerably more patience than individuals. However, rather than the individualized approach, it is more likely that everyone will be forced to endure the same exposure and teaching methods which technology will allow. Some students may like these new approaches more than others. At some point in the future, the diversity available with technology will show great benefits by providing options for different learning styles. This is one of the true benefits which technology will allow.

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