Journal of Agricultural Education
Volume 32, Number 1, pp.41-46
DOI: 10.5032/jae.1991.01041

INTEGRATING MICROCOMPUTERS AND RELATED TECHNOLOGIES IN AGRICULTURAL EDUCATION

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Microcomputers are used in nearly every phase of agricultural business and industry. To properly equip graduates to work in agriculture, teachers have begun to incorporate microcomputers and related technologies into the curriculum. Important microcomputer-related technologies available today include telecommunications hardware, printers of all kinds, plotters, remote sensing and control devises, optical scanners, video-disk equipment, many other hardware devices as well as the associated software to operate the systems (Camp, Moore, Foster, & Moore, 1988). Agriculture teacher educators and state supervisors continue to examine their roles in supporting the adoption of such new technologies in agricultural education.

Background

Experience: At the outset of the microcomputer revolution in education, there was little consensus about what we ought to teach. Malpiedi (1989) reminded us that in the early 1980s, computer instruction frequently consisted of nothing more than BASIC programming. Those of us who participated during the early years of the microcomputer revolution need little to remind us of such uncertainty, perhaps even mistakes.

During the 1980s, educators came to believe that microcomputers could be used for many things, with programming being one of the least important (Camp et al., 1988). Important computer applications that emerged were: management tool for decision-making, computer assisted instruction (CAI), computer managed instruction (CMI), and classroom telecommunications (Malpiedi, 1989; Seymore & Sando, 1986).

Related Research: The expanded educational applications of microcomputers resulted both from teachers' experience and from a growing body of research. Advocates of the educational computing movement produced a massive body of literature, including several journals devoted solely to computer use in the learning environment. In the current article we will limit our discussion to studies of specific interest to agricultural education. Most research on computer use in agricultural education has been focused in three general areas: competency studies, status studies, and to a lesser extent instructional studies.

Competency Studies: In one of the earliest studies in the field, Hudson (1983) used a delphi approach to determine the microcomputer competencies needed by agriculture teachers. Miller and Foster (1985) surveyed agriculture teachers from two mid-western states to determine the competencies they perceived as important to agriculture teachers. Tesolowski and Roth (1988) conducted an analogous study to identify competencies needed by vocational teachers in general.

Status Studies: With the expanding use of microcomputers in agricultural education, came a series of status studies. Henderson (1985) examined the use of microcomputer hardware and software in Illinois. Zidon and Luft (1987) reported on the status of microcomputer utilization in North Dakota. Miller and Kotrlik (1987) conducted a national study for all agriculture teachers. Raven and Welton (1989) conducted a more recent study on microcomputer use in agricultural education in Kansas.

Instructional Studies: The Miller and Foster (1985) study recommended, among other things, that research was needed to determine the efficacy of computer assisted instruction in agricultural education. As a result of her research, Henderson (1985) reached the same conclusion. It was with the backdrop of a growing number of such concerns expressed in the literature, that researchers in agricultural education have studied the efficacy of microcomputer use as an instructional tool.

Becker and Shoup (1985) developed a CAI package and demonstrated its effectiveness in teaching a concept in agriculture. Bowen and Agnew (1986) found no differences between a microcomputer-based approach to test administration and a traditional paper-and-pencil test of the same content at the college level. Rorbach and Stewart (1986) found that a CAI package was less effective than lecture/discussion in teaching a rather complex agricultural economics concept, again at the college level. Birkenholtz, Stewart, McCaskey, Ogle, & Lindhardt (1989) reported no differences when comparing three CAI methods with traditional lecture/discussion.

Problem and Purpose

Problem: A number of studies, such as those cited earlier have provided information on how microcomputers and related technologies work in instructional programs, how teachers are using them, and even what competencies teachers need to use them. But, research is not available to help us conceptualize a strategy or framework for integrating microcomputers and related new technologies into the agricultural education curriculum. Indeed, the framework with which our teacher educators and teachers have proceeded with the integration of such technology into the curriculum has been based largely on trial and error--as the ill-fated experiment with BASIC programming illustrates. Typically teachers are provided with inservice based on the intuition of teacher educators and then encouraged by state department of education staff to integrate computers more fully into their programs.

Purpose: The underlying purpose of the part of the study being reported in the current article was to provide an empirical basis for curriculum planning in agricultural education vis-a-vis microcomputer and related technologies. To address that underlying purpose, we examined the broad question, "What is needed to facilitate full integration of microcomputers and related technologies into secondary level agricultural education?"

Procedures

A modified delphi approach was used to conduct this research. A panel of experts was identified a priori to react to a series of three questionnaires. Panelists' comments and reactions from each round were summarized and reported on the next instrument. Then, the respondents were invited to make further comments and reconsider their previous responses. With delphi, panel members are urged not to compromise their positions to that of the majority, but to reflect during the process in addressing the question of "what ought to be". Because the experts' anonymity was protected, no single individual had more influence due to position or status.

Delphi Panel: To identify the delphi panel, we started with the National FFA Computer Technology Advisory Committee and the Technology Committee of the American Association of Teacher Educators in Agriculture. Those contact persons were asked whether they actually considered themselves experts and then to nominate others whom they considered experts. From the total list, we identified a delphi panel which included agricultural education teachers, teacher educators, state supervisors, and representatives from computer-intensive agricultural industries. The procedure led to thirty panelists for round one, twenty-four of whom continued in round two, and twenty-one who completed round three.

Instrumentation: The first round instrument included a series of questions (see Figure 1) designed to address the purpose of the study. Each questions was open-ended to elicit the respondent's opinion and to encourage him or her to elaborate, justify, or expand on that opinion. This open-ended approach follows recommended procedures for delphi that do not impose researcher bias through instrumentation. The directions encouraged respondents to list their ideas, to rephrase the questions to suit their perceptions, or even to add their own questions.

Figure 1. Questions on first-round delphi questionnaire.

1. How should state curricula and curricula guides be used to implement computing in agriculture?

2. What curriculum materials, teaching aides and/or inservice assistance are needed to implement computing in the local agricultural program?

3. How should curriculum materials be used to implement instructional technology in agricultural education?

4. What facilities and equipment are needed to implement computer applications in agricultural education curriculum?

5. What should be the uses of computers in local agricultural education programs?

Round two and three instruments were constructed from statements generated in round one. The respondent then checked an agree/disagree box and made explanatory comments in a space following each statement.

Data Collection: The thirty panelists received a cover letter, an abstract of the study, a questionnaire, and a postage-paid envelope during round one. Twenty-four members of the panel returned usable responses to round one. Non-respondents were dropped from the panel without further follow-up, leaving those who were interested in the study and who had time to respond. The remaining experts were judged to adequately represent the respondents in the original panel.

The responses provided the basis for the round two questionnaire. Round two mailing included a cover letter, the research instrument with an "agree/disagree" box and comment area following each statement, and a postage-paid return envelope. After a ten-day response period, twenty-one responses were received and recorded to formulate the round three instrument.

Round three procedures were similar to round two. In addition, the number of agree and disagree votes and comments from the previous round were listed on the new instrument. Also, each individual's previous response was recorded so each person could compare his or her views with those of the group. Panelists considered their positions along with the opinions of others, then responded. All twenty-one respondents from the previous round completed round three.

Data for round three indicated sufficient consensus and limited change from the second round to suggest that additional rounds were not necessary. Hence, the delphi terminated with this round. Frequencies and percentages were calculated for each statement. Commentary from respondents, especially on round three, were recorded and analyzed to give insights on respondents' viewpoints.

Findings

A majority of the experts felt that too few computing and computer-related curriculum materials and guidelines are available for agriculture teachers. One commented:

- Most states do not have current curricula or guides for agricultural education. The materials are often outdated, obsolete and are rarely used.

All panelists felt that a curriculum for instructional computing in agriculture is needed and that it should address computer applications, uses of computers, types of computing and benefits of computing related to agriculture, see Table 1. The nature of the curriculum guidelines the

Table 1
Areas That Should be Included in State Curriculum Materials or Curriculum Guide to Integrate Computer Technology in the Agricultural Instructional Program

Items	Agree f / %	Disagree f / %
• Uses of computer applications in instruction	21 / 100%	
• Approaches to using computer applications for instruction	21 / 100%	
• Understandings students should have of computers	21 / 100%	
• Benefits acquired by use of computers	21 / 100%	
• List of software	20 / 95%	1 / 5%
• List of teaching aids	20 / 95%	1 / 5%
• Core teacher competencies	19 / 90%	2 / 10%
• Roles of teachers, teacher educators and supervisors	18 / 86%	3 / 14%
• Hardware and software standards	16 / 76%	5 / 24%
• Funding levels needed to implement computer technology	4 / 80%	17 / 20%

respondents wanted was not as clear. Some felt that separate documents dedicated to computer applications would be desirable, while others felt that existing guidelines or curriculum documents could be modified to integrate computing technologies.

In a minority view, two of the twenty-one experts felt that new technologies such as computers are receiving too much attention and that separate treatment of them should be minimized. For example, one expert recommended lumping all new technologies together:

- I suggest the development of a state guideline for implementing [all] technology in agricultural education.

Curriculum Guidelines: Most experts argued that general guides should be written with enough specific examples to explain the content properly. The predominant belief the respondents expressed was that this approach protects local program autonomy while providing sufficient structure for a state focus. Quotes from two panelists illustrate the point:

- Curricula guides are usually used as nothing more than that--guides.
- ...[curriculum guidelines] should guide instructors on the best uses and approaches...

State Curriculum: In comparison, the respondents indicated that state curriculum should provide detailed content from which teachers can formulate an instructional program. Experts, especially teachers, gave illustrations of what should be included in a state curriculum:

- exercises that supplement the instructional areas.
- a series of basic applications
- activities that teachers can incorporate into lessons...
- templates and software applications oriented to student projects

Teachers on the panel explained that they don't have the time and expertise to develop curriculum on emerging technologies. Hence, they felt curriculum writers should develop materials ready to use in the classroom, easily updated, adaptable to various teaching styles, and suitable for school situations. Overall, the respondents indicated that teachers need publications with guidelines and teaching content, but the teachers on the panel argued that they would prefer to adapt and implement a curriculum based on their own professional judgement as shown by this comment:

- Decisions regarding the agriculture curriculum in my state [are] left to the individual school district. Very little can be done to mandate the use of computers in the classroom at the state level. However, the state curriculum should include specific tasks on computer use. The key is that [the] agriculture teacher [needs to] become educated to use computers.

Several experts were concerned about the conceptual base for and focus of a curriculum on agricultural computing. For some experts computer applications that teach process (i.e., general applications) skills are more desirable than a task-centered approach (i.e., single task) as illustrated by this comment:

- [Teachers] must show [students] what processes are learned and how they benefit students. In other words the tools [computers and their applications] learned are only a vehicle to accomplish something better.

The panel indicated that the curriculum should specify duty areas, tasks to be taught, performance standards, and core competencies.

Resource Materials: All but one expert felt that guides and curriculum materials should list resources and teaching aides on computer uses. The expert who disagreed felt a list would be problematic because it would need updating too frequently.

Standards for Hardware and Software: Most experts felt there should be state standards (76% agreed, 24% disagreed) for hardware and software but most of these gave their support to statewide networking only. In general they indicated that selection of technology should be a decision left to local school districts, partly because rapid changes in technology would outdate state standards too quickly.

Similarly, they felt that the level of funding to support instruction on computing should be a local decision. Only twenty percent of the experts felt that funding level was an appropriate area for the state to specify or for curriculum guides to address. Reasons for leaving this area to the local school level were:

- fluctuating prices of hardware and software...
- the state provides [only] limited funding...
- regional differences in prices...
- listing would become dated quickly...
- situational differences in schools...

Teacher Preparation: Most of the experts (90% agreed, 10% disagreed) advocated core teacher competencies on computing, specifically those dealing with applications and practice. Those who disagreed felt it was a function of teacher certification and not an appropriate subject to address in state curriculum or guidelines.

Implementation: Eighty-six percent of the experts believed that the roles of teacher educators, state supervisors, and agriculture teachers in implementing microcomputers and related technologies in secondary programs need to be clearly delineated in the state curricula and curriculum guides. The remaining fourteen percent of the respondents disagreed. Comments offered by those who disagreed indicated a feeling that the roles either should be addressed in the state plan rather than in the curriculum guides or that they should simply be ignored because the "roles are obvious."

Discussion and Implications

Previous research on computer use in agricultural education focussed on teacher competencies, computer applications, and instructional uses. This study takes a more conceptual approach by addressing curriculum guidelines and documentation needed to address educational computing in agriculture--i.e. What ought to be?

Our findings suggest that agricultural teachers are often disadvantaged by limited curriculum materials and guidelines at the state level. New technologies such as computing are only one example of this shortage. It is incumbent on leaders in teacher education and state supervision to ameliorate that disadvantage in a more timely manner that is currently the case in many states.

State curriculum guidelines on computing should provide a broad overview and framework for curriculum development and implementation at the local level. In comparison, state departments of education and teacher education programs should provide curriculum materials from which teachers select and adapt materials relevant to local conditions. State standardization should be limited to areas that apply to all schools such as statewide networking, teacher preparation, and curriculum implementation. This minimalist approach would provide a state focus and framework, yet foster individual school program development to meet local needs.

Both curriculum guidelines and curriculum content on computing are needed. Whether these items should stand alone or be integrated into other documents depends on the state's approach to curriculum development. Areas which state curriculum materials and curriculum guidelines should address are computer applications, uses of computers, types of computing, benefits of computing related to agriculture, and a list of teaching resource materials for these areas.

Clearly, technologies associated with agricultural business and industry will continue to change. This important factor mitigates against rigid standards in the development of state curriculum guidelines and content.

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