An Evaluation of Student Characteristics, Student Attitudes, and Teaching Methods on Student Achievement in an Agricultural Computer Programming Course

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The microcomputer is, perhaps, the newest educational tool to be used in the agricultural classroom. In the past, its use was primarily data processing. Now the microcomputer is being used in agricultural education for a variety of instructional purposes. This use creates a need to train students, agricultural educators, and adults on microcomputer usage. Legacy, Stitt, and Reneau (1984) state that as computers in agriculture grow, students studying agriculture will need to understand this new technology.

If agricultural educators are to use the microcomputer effectively and efficiently, the body of knowledge regarding microcomputer usage must grow. Previous research has generally focused on the differences in student achievement and/or attitude when comparing computer assisted instruction to other teacher methods (Russell, 1984; Rota, 1981; Tsai & Pohl, 1978; Friesen, 1976; Broh, 1975; Kockler & Netusil, 1974; Rice, & Perrin 1973). However, very little research has been conducted on the factors affecting the development of computer skills, or the factors affecting the achievement and/or attitude relative to computer usage. To improve the effectiveness of the computer as a teaching tool, these factors need to be identified.

Objectives of the Study

The primary objective of this study was to identify the factors affecting student achievement or attitude in a BASIC computer programming course in the Agricultural Engineering Department at Iowa State University. The specific objectives were:

1. To determine if there was a significant difference in student achievement or attitude when comparing teaching methods on 28 different student characteristics.

2. To determine if there was a significant difference in student achievement when comparing student attitude.

Journal of the American Association of Teacher Educators in Agriculture
Volume 26, Number 4, pp.34-42
DOI: 10.5032/jaatea.1985.04034

3. To determine if there was a significant difference in student achievement when using computer-assisted instruction compared to the lecture-discussion teaching method.

Methods and Procedures

The sample for this study consisted of 103 students in the College of Agriculture at Iowa State University enrolled in the Agricultural Mechanization 180X course. The students were enrolled during the two successive semesters of Fall 1983 and Spring 1984.

A pretest-posttest experimental/control group design was used with the degrees of freedom determined by the number of categories for each test. The classes were randomly assigned to a treatment or control group, for a total of 61 students in the control group and 42 students in the treatment group. The treatment group was taught with computer assisted instruction, while the control group was taught with the lecture-discussion method of instruction. The course instructors were randomly assigned to either group and were also counter balanced to reduce instructor differences.

Student achievement was measured with a pretest and posttest knowledge examination. Student attitude toward microcomputers and microcomputer usage was measured with a pretest and posttest attitude inventory. Student characteristics were obtained from a demographic survey. All instruments were pilot tested during the summer semester in 1983.

An analysis of covariance model was used to measure statistical differences with the appropriate pretest score as the covariate.

Cronbach's Alpha Coefficient was used as a reliability estimate for the knowledge test and attitude inventory. The reliability coefficient ranged from .79 to 90.

Student Characteristics Findings

The following summarize the student academic characteristics obtained from the demographic survey:

a) mean years of vocational agriculture at the secondary level was 0.84 years,

b) mean semesters of secondary level mathematics was 5.64 semesters,

c) mean post-secondary semesters of mathematics was 2.46,

d) mean secondary level mathematics grade was 2.97 (2="C"; 3="B"),

e) mean post-secondary mathematics grade was 3.73 (3="C"; 4="B"),

f) highest grade subjects at the secondary level were mathematics, science, and vocational agriculture,

g) lowest grade subjects at the secondary level were mathematics, history, and English,

h) best liked subjects at the secondary level were science and vocational agriculture,

i) least liked subjects at the secondary level were mathematics, English, and history, and

j) mean typing ability was 2.78 (2=11-20 wpm; 3=21-31 wpm).

The following summarize the major computer-related characteristics obtained from the demographic survey:

a) over 70% had computer experience,

b) over 70% had no mainframe or microcomputer formal instruction,

c) less than two percent owned a computer,

d) less than eight percent of the students' parents owned a computer,

e) mean years basic calculator experience was 7.26 years,

f) mean years programmable calculator experience was 0.24 years,

g) mean hours on video games was 1.36 (1=10 hours; 2=11-50 hours). Almost 14% of the students had more than 50 hours of experience playing video games.

Findings

An analysis of covariance was used to test if students' posttest knowledge or attitude scores were affected by the teaching method. The results are found in Table 1. No significant differences ($p < .05$) were found. Computer assisted instruction, therefore, was neither superior or inferior to the lecture-discussion method when teaching BASIC computer programming.

Table 1

F-values and Probability for Posttest Knowledge or Attitude Scores with Appropriate Pretest Score, Teaching Method, and Attitude

Analysis of covariance test	*F* Statistic	*F* Probability
Posttest knowledge with pretest knowledge and teaching method	.34	.56
Posttest attitude with pretest attitudes and teaching method	.17	.68
Posttest knowledge with pretest knowledge and attitude	1.84*	.07

Note. *Significant at $p<.10$ level

When the students were grouped by their pretest attitude and knowledge scores, a significant difference ($p <.10$) was found in posttest knowledge scores. This suggests that student achievement was influenced by student attitude. There was a definite positive trend between pretest attitude scores and posttest knowledge scores. In fact, the data showed a 50% increase in posttest knowledge scores as pretest attitude scores increased.

Student characteristics were analyzed individually using the analysis of covariance to determine their effect on student attitude. The results, as listed in Table 2, showed that only two characteristics were significant ($p <.05$). A significant difference was found when students were grouped by typing ability or computer experience. Generally, students who could type faster had higher posttest attitude scores. Posttest attitude scores also tended to increase as computer experience increased. In general, the fear or intimidation of using a computer dissipates as students become more in control of the computer and their attitude becomes more positive.

Significant differences were found in posttest knowledge scores for some student characteristics as shown by the data in Table 3.

When students were grouped by the subjects in which they earned their highest grades at the secondary level, a significant difference ($p <.10$) was observed. The students with the highest grades in science, English, and mathematics also had the highest knowledge scores. Similarly, Friesen (1976) found that students with good prior achievement in mathematics achieved the best in a university mathematics course in which computers were used.

Table 2

F-values and Probability for Posttest Attitude Scores with Pretest Attiude Scores (Covariate) and Selected Student Characteristics

Variable description	*F* Value	*F* Probability
Student characteristics:		
Setting where you were raised	2.05	0.13
Semesters of vo-ag in grades 9-12	0.64	0.53
Subject of highest grade in grades 9-12	0.72	0.63
Subject of lowest grade in grades 9-12	1.21	0.31
Best liked subject in grades 9-12	0.59	0.76
Least liked subject in grades 9-12	0.99	0.43
Semesters of math in grades 9-12	0.83	0.58
Average math grade in grades 9-12	0.69	0.56
Words typed per minute	2.42**	0.03
Father or male guardian occupational computer use	0.52	0.47
Mother or female guardian occupational computer use	0.00	0.96
Student classification	1.39	0.25
Student major	1.52	0.16
Computer experience	3.03**	0.03
Microcomputer instruction	0.30	0.58
Mainframe computer instruction	0.01	0.91
Mircocomputer ownership	0.00	0.95
Parent or guardian computer ownership	0.54	0.47
Basic calculator experience	1.34	0.26
Programmable calculator experience	0.79	0.38
Post-secondary semesters of math	1.71	0.13
Post-secondary average math grade	0.48	0.70
Video game experience	1.37	0.26
Computer interest from employment	0.09	0.76
Occupational plans	0.77	0.64
Factor influencing you to take course	1.38	0.24
Person influencing you to take course	0.81	0.45
Command of English language	1.03	0.40

Note. **Significant at $p<.05$ level

Table 3

F-values and Probability for Posttest Knowledge Scores (Achievement) with Pretest Knowledge Score (Covariate) and Student Characteristics

Variable description	*F* Value	*F* Probability
Student characteristics:		
Setting where you were raised	0.80	0.45
Semesters of vo-ag in grades 9-12	3.00*	0.06
Subject of highest grade in grades 9-12	1.85*	0.10
Subject of lowest grade in grades 9-12	4.29**	0.001
Best liked subject in grades 9-12	1.43	0.21
Least liked subject in grades 9-12	1.35	0.25
Semesters of math in grades 9-12	1.38	0.22
Average math grade in grades 9-12	3.49**	0.02
Words typed per minute	1.56	0.16
Father or male guardian occupational computer use	0.00	0.97
Mother or female guardian occupational computer use	0.24	0.63
Student classification	3.04**	0.02
Student major	1.86*	0.08
Computer experience	1.61	0.19
Microcomputer instruction	1.86	0.18
Mainframe computer instruction	0.01	0.91
Microcomputer ownership	1.35	0.25
Parent or guardian computer ownership	0.20	0.65
Basic calculator experience	1.50	0.20
Programmable calculator experience	0.73	0.40
Post-secondary semester of math	1.56	0.17
Post-secondary average math grade	2.36*	0.08
Video game experience	3.68**	0.02
Computer interest from employment	0.98	0.33
Occupational plans	2.35**	0.02
Factor influencing you to take course	1.34	0.25
Person influencing you to take course	3.53**	0.03
Command of English language	1.44	0.23

Note. *Significant at $p<.10$ level, **Significant at $p<.05$ level

A significant difference ($p<.05$) was found when students were grouped by their lowest grades at the secondary level. Students earning their lowest grades in mathematics, science, and history scored lower on the knowledge test.

When grouping students by grades earned in mathematics at the secondary and post-secondary level, there was a significant difference in knowledge scores. As the average mathematics grade rose, the knowledge scores rose almost correspondingly. Achievement in mathematics evidently requires the same type of ability as do computer skills and programming. The amount of mathematics in secondary or post-secondary schools produced no significant differences; only the grade earned made a difference.

When grouping students by the number of years of vocational agriculture, a significant difference ($p < .05$) was found in knowledge scores. Students with vocational agriculture experience scored significantly lower than students with no vocational agriculture. Several possible explanations exist. Instead of taking vocational agriculture, these students may have enrolled in other college preparatory courses that affected their level of achievement. Also, some secondary schools may not have offered vocational agriculture. In many cases, the vocational program likely emphasized vocational training rather than skill development needed for computer achievement.

A significant difference was also found when students were grouped by student classification, student major, and occupational plans. Limited observations for these categories make it difficult to draw any specific conclusions.

There was a significant difference in student achievement when students were grouped by the hours of video game experience. The students with the least video game experience had the highest scores. During the study, it was observed that students with more video game experience entered the class with unrealistic expectations of programming ability or immediate computer usage. When they realized that the computer was totally dependent on their communicative ability and expertise, their confidence and attitude greatly diminished which, in turn, affected their attitude.

A significant difference was found when students were grouped by the person influencing them to take the course. Six categories were identified with the "myself" category having the highest mean score. Most students enrolled to learn how to use a computer even though it was not part of their program of study. Thus, student desire is a good motivator to achieve in a BASIC programming course. Wanting to be enrolled in the class rather than having to be there made a difference.

Conclusions and Recommendations

As microcomputers become more widely used in teacher education and secondary/post-secondary programs, this study will add to the body of knowledge regarding the effective use of microcomputer technology.

It appears that mathematic's ability in one of the prime indicators of achievement in computer skills. This research shows that it is not the quantity of mathematics that is crucial, but rather the ability and retainment of those skills as measured by the grades received. Since agriculture is now involved and likely will be more involved in the future with computers, agricultural education programs, should place adequate emphasis on mathematic's skills. For many post-secondary agricultural computer programming classes, prerequisite mathematic's courses and specific levels of mathematics will help students to maximize their potential.

The study also showed that computer experience tended to influence student attitude towards microcomputers, which in turn influenced student achievement. By introducing students to computer skills early in vocational agriculture and other secondary education programs, students will overcome the fear and intimidation of the computer, which in turn will improve their attitude towards computer usage.

Although this study did not find a positive relationship between the number of semesters enrolled in vocational agriculture and student achievement, computers can still play an important role in a vocational program. This study focused on computer programming rather than computer applications. Perhaps the role of the vocational program is to emphasize the application and use of computer programs rather than the actual programming of computers in the research and development of computer programs.

Self-motivation to learn computer skills is an important factor affecting the development of computer programming skills. Thus, teacher education advisors and secondary/post-secondary teachers need to impress upon students the advantage of possessing computer skills rather than having students take a computer class just to meet program of study requirements.

Students in agriculture need to develop typing skills in order to use the computer effectively.

Microcomputer ownership, formal instruction on either microcomputers or mainframe computers, and programmable calculator experience did not significantly influence student achievement. At this point in time, agricultural educators could plan agriculture computer programming classes for a broad spectrum of agriculture students regardless of their computer background.

This study confirms many other studies showing that computer assisted instruction is as effective a teaching method as lecture-discussion. The computer should be viewed as another teaching aid to supplement and enhance the lesson material. The use of computer assisted instruction in the classroom will allow the teacher more time for individualized instruction or other teaching activities.

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