Core Agricultural Mechanics Competencies for Teachers of Vocational Agriculture

Karl O. Polson

Pulaski County High School
Pulaski, Virginia

Throughout much of the history of vocational agriculture education, students, and teachers have been primarily male and from the rural population of the United States. Great similarities existed in the experiences and backgrounds of the individuals in both groups, and in the skills they possessed. This situation has been changing in recent years, along with the very nature of vocational agriculture.

As the structure and diversity of agriculture changed at an ever more rapid rate through the decades since the 1950's, farm populations decreased while the numbers of vocational agriculture programs; students and teachers increased, often appearing in urban or other nonrural settings. Ever larger numbers of students with nonfarm, and even nonrural, backgrounds appeared in vocational agriculture classrooms. Among this new student and teacher clientele were many females, a group not previously found in most agricultural classrooms. By 1979 they had become an important factor, representing 17.2% of enrollment, according to Rawls (1980).

The increasing diversity of both student and teacher backgrounds assured a wide variety in the skills represented in the classroom. No longer can assumptions be safely made about the minimum level of proficiency students bring either to vocational agriculture or to agriculture teacher education programs. Both Newcomb (1976) and Herr (1976) pointed to ever increasing numbers of students preparing to become vocational agriculture teachers who have no agricultural experience prior to college. These students are heavily dependent on collegiate programs of instruction to provide both the professional and the technical skills they need in the classroom.

Coupled with increasing mechanization and reliance on technology of all areas of agriculture, the background diversity of college students appears to be presenting new problems for agricultural teacher educators in identifying the skills actually needed by teachers entering the classroom. The Education and Research Committee of the American Society of Agricultural Engineers (1968) recognized implications of increasing specialization in vocational agriculture programs for teacher preparation in agricultural mechanics. The committee determined that agricultural mechanics instruction was a component of all the agricultural specialists in varying degrees, a view long shared by most teacher educators. The committee recommended that training in mechanics vary according to needs of the individual's specialization. Geographic mobility also presents a question of whether technical teacher competencies developed in one location are equally applicable in another. Jacobs (1972) found that mechanics skills were

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widely applicable in the states of the Western region, but what of the rest of the country?

Prevailing opinion among agricultural educators has been that all vocational agriculture teachers need at least some mechanics skills. Many teacher preparation institutions require all prospective teachers to take one or more courses in agricultural mechanics or engineering. Little clear information related to technical mechanics competencies actually needed by all teachers of agriculture is available. One practice is to use teachers as advisory council members for teacher education programs and to ask their perceptions of their needs. These perceptions may or may not be clearly related to what teachers should actually be teaching.

Teacher preparation in agricultural mechanics has largely remained structured as it was when vocational agriculture was production agriculture. While it is reasonable to assume that mechanics skills are generalizable and transferrable to a variety of specialists in agriculture, it is not generally known which competencies are most needed by teachers, or which are common to several or all specialties.

The lack of data to clearly identify the mechanics competency needs of all vocational agriculture teachers, if indeed such a need exists, provided the primary focus for this investigation. The question of applicability of the competencies over a wide geographic area provided a secondary focus. Together, these questions for programs for preparation for agricultural teachers led to the conduct of this study.

Research Questions

Two purposes of the study (Polson, 1982) were to identify the common core of agricultural mechanics competencies which all teachers of vocational agriculture should possess, and also to determine if those competencies were common to all regions of the country. The research questions addressing these purposes were:

1. What agricultural mechanics competencies are common to, and needed by, teachers of all vocational agriculture taxonomies (specialty areas)?

2. Do agricultural mechanics competencies needed by all vocational agriculture teachers differ by regions of the respondents?

Research Procedure

Sample Investigated

The sample for this study represented four separate groups surveyed nationally during the 1981-1982 school year. The groups were: state supervisors of agricultural education, agricultural teacher educators, teachers of vocational agriculture, and agricultural program craft/advisory committee members.

The United States was stratified, using the four regions of the American Association of Teacher Educators in Agriculture (AATEA). Three states were selected from each region with the use of a random numbers table. A maximum of three supervisors of agricultural education and three agricultural teacher educators were selected from each state, again using a table of random numbers. All were surveyed where three or fewer existed in a state. Teachers and committee members were purposively selected through their association with a program in an agriculture teaching speciality which the state supervisor identified as outstanding. Advisory committee members were identified by teachers, on a form for that purpose sent with their survey instrument. The final sample consisted of 28 supervisors, 36 teacher educators, 67 teachers of agriculture, and 127 craft/advisory committee members, for a total of 258 individuals.

Instrumentation

The instrument was developed with the assistance of a panel of experts asked to evaluate and respond to a proposed list of agricultural mechanics competencies. The panel was unanimous in the opinion that the list was comprehensive, and based on their comments and evaluation, the list was refined to 90 competencies. A four point Likert-type scale was added to rate the extent to which respondents believed that agricultural teachers need each competency. The instrument was then field tested. Results of the field test were evaluated, final instruments were prepared, and mailings were begun.

Methodology

A mailed survey procedure was used to collect the data. Due to the necessity for limiting the size of the sample, and to the national scope of the study particular attention was paid to obtaining a high response rate. The survey method developed by Dillman (1978) was employed, and resulted in an overall response rate of 80.6%. Summaries of response rates for all four groups in the sample are presented in Table 1.

Table 1

Summary of Mailings and Response Rates

	Instruments mailed	Responses received	Percent response
Teacher educators	36	33	91.7
State supervisors	28	25	89.3
Agriculture teachers	67	54	80.6
Committee members	127	96	75.6
Total	258	208	80.6

Table 2

Competency Clusters

Cluster	Number of competencies
1. Plans and materials	6
2. Welding	19
3. Carpentry	7
4. Cold metal and tool fitting	10
5. Painting and preserving	4
6. Concrete and masonry	5
7. Electricity	5
8. Power and machinery	21
9. Land measurement	7
10. Plumbing	6
Total	90

Statistical Analysis

Data analysis was accomplished by determining mean rankings for each competency by each sample subgroup. The subgroup means were then used to calculate a grand mean for all respondents. The choice of grand means was made in order to eliminate effects of unequal group size on means for the competencies. A mean of 2.0, on a four point Likert-type scale which ranged from 0 to 3, equal to the rating for "moderate" skill needed by teachers was used as the determiner for competencies to be included in the core of mechanics competencies needed by all teachers of vocational agriculture.

Table 3

Core Agricultural Mechanics Competencies for Vocational Agriculture Teachers

Rank	Competency	Grand mean
1.	Determine and compute bill of materials	2.482
2.	Measure and mark wood and/or metal	2.444
3.	Use stationary and portable woodworking power tools	2.424
4.	Saw, plane, chisel and/or bore wood to dimension with hand or power tools	2.411
5.	Arc weld in flat position, all joints	2.399
6.	Clean and store tools and equipment	2.379
7.	Set up and operate oxy-fuel gas welding and heating equipment	2.376
8.	Maintain agricultural tractors, equipment and machinery	2.369
9.	Select, use and store fuels, oils and greases	2.363
10.	Use parts and service manuals and order engine or equipment parts	2.349
11.	Maintain and service engine lubrication systems	2.345
12.	Troubleshoot engines	2.337
13.	Cut metal with oxy-fuel gas cutting torches	2.317
14.	Maintain service and/or repair fuel and air system on spark ignition engines	2.315
15.	Maintain and/or service engine cooling systems	2.314
16.	Sharpen knives, chisels, plane irons, axes, twist drills and/or other cutting tools	2.312
17.	Prepare metal for welding	2.308
18.	Use hand woodworking tools	2.305
19.	Select and maintain oxy-fuel gas tips and torches	2.303
20.	Operate and adjust agricultural tractors, equipment and/or machinery	2.301
21.	Operate bench and/or portable grinding equipment	2.282
22.	Classify and select arc welding equipment and supplies	2.263
23.	Weld in flat position with oxy-fuel gas equipment, all joints	2.210
24.	Select, maintain and use grinding wheels, handstones and/or files	2.206
25.	Splice electric wire	2.204
26.	Identify and select electrical tools, devices and conductors by type and use	2.195
27.	Evaluate engine or equipment parts for replacement or reconditioning	2.165
28.	Use measuring devices for accurate parts inspection on engines and equipment	2.163
29.	Maintain, service and/or repair engine ignition/electrical systems	2.143
30.	Arc weld in vertical, horizontal and/or overhead positions, any or all joints	2.139
31.	Install or replace electrical fixtures and/or wiring	2.115
32.	Clean, disassemble, inspect and reassemble engines	2.113

Table 3 continued

33.	Prepare surfaces for paint or finishes	2.103
34.	Identify, select and use wood and/or metal fasteners	2.099
35.	Maintain, service, and/or repair fuel and air systems on diesel engines	2.097
36.	Prepare engines for storage	2.093
37.	Select and use taps, dies and screw extractors	2.090
38.	Braze with oxy-fuel gas equipment, all joints	2.090
39.	Plan and/or interpret electrical circuits and wiring diagrams	2.087
40.	Maintain and/or repair plumbing and protect from freezing	2.078
41.	File and/or drill cold metal	2.076
42.	Set up and adjust level or transit	2.075
43.	Estimate bill of materials for concrete and/or masonry	2.068
44.	Replace tool handles	2.057
45.	Read and interpret plans or blueprints	2.053
46.	Select and maintain applicating equipment for painting, finishing and/or preserving	2.052
47.	Use stationary and portable metal working equipment and tools	2.045
48.	Determine orders for ready-mixed concrete	2.045
49.	Determine elevations with level or transit	2.036
50.	Identify engines by model, type and make	2.021
51.	Identify and select plumbing equipment, supplies, pipe, and fittings	2.017
52.	Service, maintain and adjust bearings on equipment and tractors	2.008
53.	Identify and/or select metals	2.006

Note. Based on a scale of 0 to 3, with 0=none and 3=extensive

The 90 competencies were grouped into 10 general categories or clusters, and summated scores were generated for each cluster. A one-way ANOVA was used to analyze those data for differences among AATEA regions, using a .05 alpha level. The 10 competency clusters,and the number of competencies in each, are listed in Table 2.

Findings

Fifty-three of the 90 competencies included on the instrument achieved a grand mean equal to the rating for "moderate" skill needed by teachers of vocational agriculture. These competencies were considered to be the group which comprises a core of competencies in agricultural mechanics needed by all teachers of vocational agriculture. The competencies identified as core competencies are listed in rank order in Table 3, with the grand mean achieved by each.

All competencies were grouped into clusters and analyzed for differences in teacher need among regions. Analysis was done by one-way ANOVA using a .05 alpha level. Of the 10 clusters of competencies only one, "land measurement," proved to have a significant difference at the .05 level. In order to determine where the difference(s) lay among regions it was necessary to use a post-hoc multiple range test. The Scheffe' test was used for this purpose, and showed the difference to exist between the Eastern and Southern regions.

Conclusions and Implications

The study identified 53 agricultural mechanics competencies which should be possessed by all vocational agriculture teachers. Teacher educators, state supervisors, agricultural teachers, and craft/advisory committee members representing agricultural business and industry indicated the need for agricultural mechanics competencies on the part of teachers in all specialty areas of agricultural education. Analysis of the competency clusters by region indicated there is very little difference in the mechanics competency needs of teachers among regions of the United States defined by the AATEA.

The findings of the study have implications for preservice and inservice teacher education programs throughout the United States. In most cases, teachers will experience difficulty in acquiring the competencies in mechanics which they need if provisions for acquisition are not made in the preservice teacher education program. Analysis of presently available technical offerings and requirements in agricultural mechanics for preservice teacher education students, to assure that instruction in the needed competencies in available, is indicated. Adjustments to advisement procedures with a view to assuring acquisition of the core mechanics competencies by all teacher education students should be made. Alternative means of competency acquisition, and verification, may also be desirable and might well include cooperative placement and training programs. Inservice teacher education programs to develop and/or improve core mechanics competencies of teachers should also be developed and offered in a systematic manner.

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