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An Analysis of Farm Machinery Operation Skills Possessed By Students Entering Agricultural Education

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The vocational agriculture instructor must have a repertoire of technical skills and be competent in their performance. It is difficult to acquire these competencies during the length of time devoted to study towards a Bachelor's Degree in Agricultural Education. Teacher educators in agriculture have always been concerned about the skills competency level of freshmen and transfer students from other programs or institutions. How to provide experience to these students in an undergraduate curriculum is a question debated whenever curriculum is discussed.

Historically a farm background was a prerequisite for admittance to the agricultural education curriculum. The rationale for this prerequisite was that an individual with an agricultural background would have acquired many of these skills. This rationale places great faith in the farm background.

During the fall of 1977 a skills inventory was completed by incoming students to the Agricultural Education undergraduate program at the University of Minnesota. At the same time, the students were asked to complete a questionnaire designed by the authors concerning their background in machinery operation as a part of the agricultural mechanics section of the skills inventory.

The reasons for highlighting the operation of agricultural machinery as a special section of the skills inventory were twofold: (1) it is one of the areas of skill development that is difficult to provide in the undergraduate curriculum in the College of Agriculture, and (2) machinery costs are second only to land costs in production agriculture.

The authors believe that (1) the operation of the machinery is a critical and basic competency, (2) if a vocational agriculture instructor is to teach the area of power and machinery, it is essential to be able to operate the machine being studied, and (3) the ability to operate the machine will greatly enhance the service and maintenance phase of the instructional program. In addition, since the operation of farm machinery is seldom listed as a course objective in college curricula, it must be assumed that the operation of machinery is a part of each student's prior background, or some educators might feel the operation of machinery is too vocational in nature to be of concern to the university.

With these facts and assumptions in mind, it was the purpose of this paper to analyze the data gathered on the machinery operation experience of a group of incoming students.

The students were asked if they had operated various agricultural machines. If so, they were requested to assess their level of achievement: beginner, advanced or proficient. If the students had not operated machinery, they were asked if they could foresee an opportunity to do so in the near future. The machines included in the questionnaire and the responses are listed in Table 1.

The questionnaire was completed by 49 students; 57 percent (28) were transfers into the Agricultural Education program at the University of Minnesota. As of January 1979, 53 percent (26) were still in the Agricultural Education undergraduate curriculum, seven had graduated with a Bachelor's Degree and 16 had either transferred out or dropped out of the curriculum. Forty-three of the 49 were males. Seventy-eight percent (38) had indicated they had prior farm experience.

Table 1 displays the distribution of responses to the original questionnaire. The authors selected a limited number of machines believed to be the ones students could most reasonably be expected to have operated.

Table 2 lists the distribution of students by the number of primary machines they can operate and their transfer status. The mean number of machines operated was higher (but not significantly) for the transfer students and this was attributed to the fact these students were usually older and had more opportunity to operate machines.

Table 3 reveals the distribution of students by program status as of January 1979, and number of major machines operated. While the expected cell totals were too small to test for significance, there does seem to be a difference in the number of major machines operated between the groups. While 37 of the students could operate six of the nine major machines, the

Table 1. Distribution of Responses
Cases = 49

AGRICULTURAL MECHANICS MACHINE OPERATION

Have You Operated.....	Operated Yes	Operated No	Level of Proficiency Beg.	Adv.	Prof.	Opportunity to Develop Yes	Maybe	No
1. 4-Wheel Drive Tractor	16		12	2	3	16	9	15
2. Regular Row Crop Tractor	47		4	24	18	23	3	6
3. Tractor and Front-End Loader	44		3	26	14	24	4	6
4. "Bob-Cat" Type With Loader	24		10	12	4	18	12	10
5. Swather: Pull-Type	13		8	5	3	17	14	10
6. Hay Rake	40		6	22	12	18	8	8
7. Combine:								
a. Pull-Type	10		7	2	3	11	11	20
b. Self-Propelled	22		15	3	5	18	10	8
8. Hay Baler:								
a. Round Bales	1		2			9	12	17
b. Round Super	1		2			9	9	19
c. Square Bales	42		15	17	12	10	7	5
9. Hay and Forage Chopper	25		11	12	3	21	12	5
10. Tillage Machines:								
a. Plow-Moldboard	37		8	18	11	17	13	5
b. Disk	39		4	21	14	17	14	3
c. Plow Chisel	29		6	13	10	14	12	8
d. Field Cultivator	36		6	18	12	18	12	4
11. Field Sprayer	25		10	9	4	25	9	6
12. Planters:								
a. Corn	22		10	9	2	26	9	6
b. Soybeans	13		8	4	1	24	8	11
c. Grain Drill	30		14	15	2	25	8	5
d. Sugar Beets	1		1			8	6	26
13. Spreaders:								
a. Manure (Solid)	42		7	19	16	17	9	7
b. Manure (Liquid)	13		3	6	5	13	13	16
c. Commercial Fertilizer	22		12	7	3	20	8	10

average for all students was just over six of the nine major machines.

The distribution of students by number of major machines operated and farm background or experience is enumerated in **Table 4.** It was expected that those students with a farm background had operated more machines than those who had no farm experience. The computed Fisher's t, a test for difference in means, is significant to at least .002.

It was found that the average proficiency level of all students reporting being able to operate some of the nine major machines was less than the beginning level. No students reported being proficient in the operation of most of the machines.

If the student has not operated a machine or is at the beginner level, does the student foresee an opportunity to improve on her or his status? Only 30 students could foresee an opportunity to improve their machinery operator proficiency status. Nineteen students could not see an opportunity to improve, and of these, only one did not have farm experience. It would seem that the farm-associated students would have a difficult time, using the opportunities they could foresee, improving their situations. When non-farm students enter the agricultural education curriculum they soon discovered that the lack of a farm background must be compensated for by another experience. Therefore, all except one of these students planned to get the experience by another fashion.

The percentage of students having a non-farm background (22%) is considerably less than the College of Agriculture average, which is approx-

Table 2. Distribution of students by transfer status and number of major machines operated

Machines Operated	Students' Transfer Status: Transfer	Non-Transfer	Total
1	0	1	1
2	1	1	2
3	2	0	2
4	0	3	3
5	2	2	4
6	9	4	13
7	6	4	10
8	4	4	8
9	4	2	6
N =	28	21	49
$\bar{X}$ =	6.50	6.05	6.32
t = 2.423	Reject if /t/ > 2.021 at α = .05		

Table 3. Distribution of students by program status and number of major machines operated as of January 1979

Machines Operated	Students' Program Status: In	Graduated	Out	Total
1 - 5	6	1	5	12
6 - 11	20	6	11	37
Total	26	7	16	49
$\bar{X}$	6.12	6.42	6.10	6.16

Table 4. Distribution of students by farm experience and number or major machines operated

Machines Operated	Farm Experience: Yes	No	Total
1	0	1	1
2	0	2	2
3	0	2	2
4	3	0	3
5	4	0	4
6	10	3	13
7	9	1	10
8	6	2	8
9	6	0	6
Total	38	11	49
$\bar{X}$	6.76	4.18	6.32
t = 5.114	Reject if /t/ > 2.021 at α = .05		

imately 60 percent.

The distribution of students having operated each of the nine major machines by farm experience is given in **Table 5.** Almost all the students had operated a tractor (90%) and a baler (86%). However, only three-fourths had operated a plow. Nearly three-fourths of the students had not operated a swather. Less than half had operated a combine, planter and fertilizer spreader.

Farm experience did seem to have a significant effect on whether a student had operated the machine in question. This would be indicated by arm-chair logic and by looking at the differences in the percentages of farm background students versus non-farm background. In computing a Z to test for significant differences in proportions, it was found the only nonsignificant differences existed when comparing students on the operation of swathers, combines and grain drills.

Table 5. The distribution of students having operated the major machines by farm experience

Machine	Farm Experience Yes		No		Total		Z*
	#	%	#	%	#	%	
Tractor/Loader	37	97	7	64	44	90	3.210
Swather	10	26	3	33	13	27	.457
Combine	18	47	4	36	22	45	.642
Baler	36	95	6	55	42	86	3.372
Plow	32	84	5	45	37	76	2.61
Sprayer	23	61	2	18	25	51	2.51
Planter	20	53	2	18	22	45	2.04
Grain Drill	25	66	5	45	30	61	1.25
Fertilizer Spreader	20	53	2	18	22	45	2.04
Total	38	100	11	100	49	100	

*A significant difference in proportion exists at .05 level if /Z/>1,960.

Table 6 exhibits the distribution of mean proficiency level of students by machine, farm experience and transfer status.

The mean proficiency level for operation of the nine major machines for farm students was 1.20 whereas the non-farm students had a 1.15 average. A proficiency level of advanced was reported twice for the Tractor/Loader.

Of the machines, only the operation of the tractor, baler, plow and grain drill received more than a beginner's rating. An interesting fact is that the baler rated quite high whereas the swather was the lowest.

If it can be assumed that the operation of an agricultural machine is a basic part of the mechanized agriculture part of agricultural education, and that the students of this study were representative, then provisions must be made in the undergraduate program for operation of or assimilation of machinery operating skills.

Some may say that this type of skill development is too vocational in nature to be the responsibility of a university. However, for education to be truly vocational, the skills developed must be put to terminal use. Vocational agriculture instructors are not going to be farm machinery operators, but they will be teaching farm machinery operators.

Table 6. The mean proficiency level* of students distributed by machine, farm experience and transfer status

Machines	Farm Experience Yes	No	Transfer Status Yes	No	Overall
Tractor/Loader	2.16	1.36	2.03	1.90	1.98
Swather	.58	.46	.43	.52	.55
Combine	.74	.73	.82	.62	.73
Baler	1.89	1.18	1.75	1.71	1.73
Plow	1.79	.82	1.61	1.52	1.57
Sprayer	.95	.36	.93	.67	.82
Planter	.82	.27	.89	.42	.69
Grain Drill	1.08	.82	1.18	.81	1.02
Fertilizer Spreader	.79	.18	.75	.52	.65
Number of Students	38	11	28	21	49
Overall	1.20	.69	1.15	.97	1.01

*1 = Beginner 2 = Advanced 3 = Proficient

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