desired student performance. Including a computer simulation selection program can result in more effective instruction as indicated by student evaluation ratings. Student appraisal showed that interest, understanding, application and knowledge of animal breeding were either created or increased as a result of performing this type of learning activity.

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TEACH THE TEACHER

A Useful Workshop Model Provides University Faculty For Much Needed Instruction on Electricity in Agriculture

Leon G. Schumacher and H. David Currence

Abstract

Agriculture teachers from across the state expressed a need for electrical education in agriculture. The state Farm Electrification Council (FEC) and the university Agricultural Education Department planned and conducted eight-workshops at eight different locations in the state. Approximately 180 agriculture teachers attended the workshops. Each instructor received both hands-on experiences with electrical wiring and retraining in electrical theory.

Introduction

Although this paper explains how financial and human resources were procured to in-service specific technical subject matter, the model utilized could also be used to facilitate college-level teaching which helps solve other rural problems. The cooperative efforts of state wide organizations, university faculty, and high school teachers can provide the monetary and human resources needed to address both current and future rural issues.

Electricity use in agriculture has continually increased during recent years. According to McFate and Linhardt (1985), the use of electricity will continue to increase. With the large and varied agricultural electricity use, the service sector of the electrical power industry has become quite busy - in some cases understaffed. According to McClarney (1987), the number of "small community electricians" has declined. In short, a real need exists for electrical instruction in rural America. Agriculture teachers within the state have sensed this need and responded by requesting in-service instruction in electricity. A panel of 13 agriculture teachers meet each year to identify areas in which they need additional education. Based on their recommendations, the state Land Grant University, together with the state Farm Electrification Council (FEC), have planned and conducted off campus electricity instruction for agriculture teachers.

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The University and the state FEC have supported instruction in agricultural electricity for many years. Their decision to provide instruction in electricity was initiated at the grass roots level. High school agriculture departments are grouped into 13 geographical areas. Each area selects one delegate to represent them on the state in-service committee. The in-service committee meets bi-annually to determine the in-service needs of the agriculture teachers. Three times during the past twenty years, the agriculture in-service committee has recommended that in-service efforts focus on electricity.

As early as the 1960's, the state FEC recognized the importance of electricity education. Electricity was rapidly becoming the workhorse of modern agriculture. The state FEC organized an education committee to determine how they could best educate citizens about the use of electricity. According to John McClarney (1987), the committee decided to assist the agriculture teachers in providing electricity education to their students. After discussing their concerns with the university agricultural education/engineering faculty, the state FEC education committee decided to provide money for electricity education and teaching aids for the instructors. The instructors in turn would assist them in accomplishing their goal by teaching electricity to their students.

Developing a Meaningful Program

Developing a meaningful program would not be successful without the support and financial commitment of several groups within the state. The University faculty and administration, the industrial farm electrification council, the state department of elementary and secondary education, and the high school teachers cooperated in the planning and delivery of this program.

The University has employed a faculty member for in-service education. Part of his assignment has been to teach electricity to agriculture teachers both on and off campus. Part of the success of this in-service course was attributed to the fact that the in-service course professor who coordinated the instruction also taught

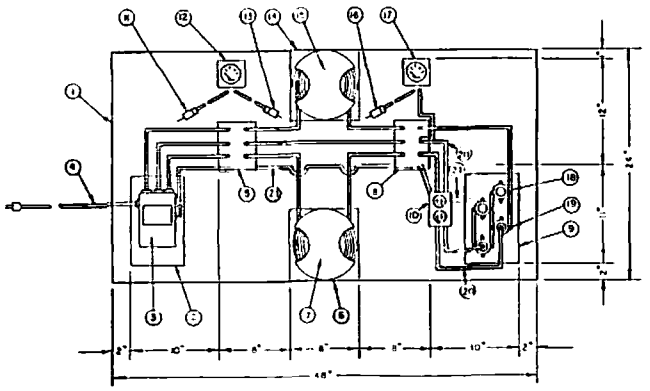

Figure 1. Wiring demonstration board

1. 26" X 4 X 5/8" plywood
2. 1/2" mounting board for fuse box
3. Fuse box
4. 12-3 with ground cord
5. 1/2" mounting board for banana jacks
6. 1/2" mounting board for 16 gauge wire
7. 100' 16 gauge wire THHN (red)
8. 1/2" mounting board for banana jacks
9. 1/2" mounting board for porcelain light fixtures
10. 20 amp duplex receptacle
11. Banana plug
12. Ammeter (0-30 amps)
13. Banana plug
14. 1/2" mounting board for 12 gauge wire
15. 100' 12 gauge wire THHN (black)
16. Banana plug
17. AC voltmeter (0-250v)
18. Surface mount porcelain light fixture
19. Surface mount porcelain light fixture
20. Grounded wire 12 gauge THHN (white)
21. Grounding wire 12 gauge THHN (green)

the course off campus. Instructors were more willing to enroll in the in-service course because their travel was minimized. In order to make off-campus instruction possible, the in-service course professor and the university coordinator of Agricultural Education obtained a grant from the State Department of Elementary and Secondary Education. The grant funded travel and lodging expenses for the professor while teaching the in-service course.

In education, a higher level of subject matter retention occurs when instructors facilitate the learning process with high quality teaching aids. This statement also holds true for electricity education. For high school agriculture instruction of electricity in the state, two demonstration boards were designed to help teach such concepts as voltage drop, proper fusing, proper grounding, and Ohm's law.

One board, the wiring demonstration board is equipped with a voltmeter, an ammeter, 100 feet of 12 AWG wire, 100 feet of 16 AWG wire, 6 Edison-base porcelain light sockets, banana plugs and jacks, two 20 ampere duplex outlets, and an Edison-base fuse type service disconnect (Figure 1). With the board, the voltage drop across the 12 AWG wire, the 16 AWG wire, and the 12 AWG wire and 16 AWG wire connected in series can be determined.

The board can also be used to demonstrate the importance of proper fusing. A piece of ni-chrome wire, a poor conductor of electricity, is placed in the circuit to simulate what happens to electrical wire when an overload occurs. When using a 3 ampere fuse, a 660 watt cone heater blows the fuse. The wire becomes red hot, however, when using a 660 watt cone heater with a 20 ampere fuse.

An electric motor demonstration board was also constructed (see Figure 2). A fused switch, a fractional hp manual motor starter, an electromagnetic motor starter equipped with a start-stop station, a limit switch, a cooling thermostat, and a ground fault circuit interrupter are a part of this demonstration board. This board is used in conjunction with two fractional hp electric motors; 1) a split phase, and 2) capacitor start - induction run. Overload protective devices for electric motors are discussed and demonstrated by overloading the motors with a Prony brake built into the carrying case (Figure 3).

The state FEC donated money during the past 20 years to assist the high schools in purchasing textbooks and materials used in constructing and updating the demonstration boards. The state FEC donated $2000.00 during 1986 to further update the wiring demonstration board and to help purchase copies of the following National Food and Energy Council (NFEC) publications: Food, Energy, and Your Future; Agricultural Wiring Handbook; Electrical Wiring Systems for Livestock and Poultry Facilities; and Farm Energy Analysis.

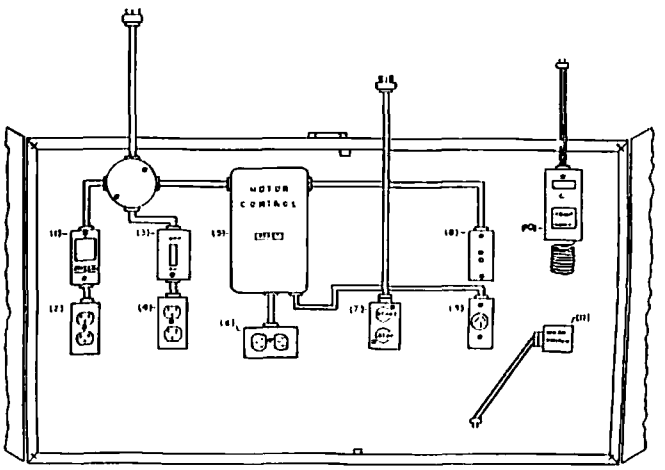

Figure 2. Motor control demonstration board

1. Fused switch
2. 20 amp duplex receptacle
3. Manual motor starter (overload protected)
4. 20 amp duplex receptacle
5. 1 hp. 115v. magnetic motor starter
6. 20 amp duplex receptacle
7. Start-stop station
8. Double banana jack to connect thermostat and limit (micro) switch
9. Junction box which connects the start-stop station to the motor control
10. Cooling thermostat
11. Limit (micro) switch

The professor for the in-service education course contacted representatives from industry and encouraged them to attend the in-service course. Field engineers were asked to speak on related topics. The agriculture teachers appreciated their insight and perspectives concerning the use of electricity. This acquainted the teachers with key area resource persons who should be called upon to help them as they teach a class in electricity.

Specialists from the university were also called upon to provide additional instruction in the latest electrical technology. This further updated the teachers (who in turn provide more up-to-date information for their students) and provided an additional contact person for the teachers to call upon as they teach their classes.

Course Outline

The course began with a general orientation session. A schedule for the remaining seven sessions for the course was determined and course registration was completed. The course textbooks were also distributed. During this session, the history of electrical power, the importance of electrical power in agriculture, electrical safety, and basic electrical terminology was discussed. Instructors were introduced to their local power suppliers and informed of safety programs sponsored by the power suppliers. A state FEC member concluded the session with a safety demonstration using a mock-up of a high voltage power line.

The second session centered around a discussion of basic electrical theory. Calculations of current, volts, power, and resistance were taught, voltage drop was explained, and the importance of proper wire sizing was emphasized. These concepts were first demonstrated on the wiring demonstration board (Figure 1). Instructors then reinforced the concepts taught by performing the activities on their own wiring demonstration board. Approximately one hour of this session was devoted to updating the electrical wiring demonstration boards to meet the current National Electrical Code (NEC).

The discussions during the third and fourth sessions centered around planning various switching circuits. Instructors were brought up-to-date on current NEC requirements for dry locations. Hands on activities included wiring a simple 3-way switching circuit, a 3-way switchleg circuit, a 4-way switching circuit, a 4-way switchleg circuit, and a switchleg 3-way with a duplex receptacle installed in the circuit. Instructors were taught to test their circuits with a multimeter. Again, one hour of each session was devoted to updating the electrical wiring demonstration boards to meet current NEC requirements.

The focus of the fifth session was interior wiring for buildings with wet, corrosive environments. The slide set; "Electrical Wiring in Livestock Confinement Buildings" and the publication "Electrical Wiring Systems for Livestock and Poultry Facilities" available through the National Food and Energy Council were used as reference materials. Field engineers from local power suppliers were called upon to present a discussion on three phase power, power transmission, and the use of heat pumps.

During the sixth session, electric motor selection and overcurrent protection for electric motors was discussed. The purposes, types, advantages, and disadvantages of electromagnetic motor controllers were demonstrated with the aid of the motor control demonstration board and motors (Figures 2 and 3). A hands on activity followed where instructors used the area electric motor control boards to reinforce the learning process.

A field trip was conducted during the seventh session. Instructors were provided an opportunity to observe electromagnetic controllers in operation. If possible, the field trip was made to a location where programmable controllers were used to operate a feed handling system. For example, you might tour a dairy farm which utilized radio transmitters, receivers and computers to control individual animal feeding. Field trip topics which have been successful included an inspection of the wiring of a confinement livestock facility and tours of electrical generation facilities. Time was also set aside for instructors to finish updating their wiring demonstration boards.

A general review session conducted during the eighth and final session highlighted how the instructors could use the materials available through NFEC and the electricity curriculum materials available through the state instructional curriculum center. A final exam was administered during this session.

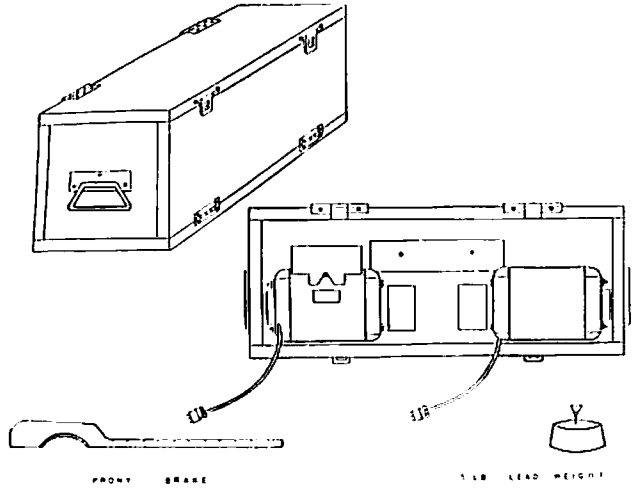

Figure 3. Electric motors and carrying case

1. 1 1/2" block of wood, ,used when applying pressure with Prony brake.
2. 1/8" deep saw notch-used to position 5 lb. lead weight.
3. Capacitor start-induction run motor.
4. Split phase motor.
5. Leather strip-frictional surface for Prony brake.
6. 2" wide by 3 1/4" belt pulley.

Reaction to the Program

As with any subject, some students tended to be very knowledgeable while others found much of what you taught new. On the average, the teachers would rather not discuss electrical theory. This may be because they lacked electrical knowledge and were afraid to show their weakness. Some instructors attended the sessions because they were searching for new ideas of how to present electricity information to their students. Most of the instructors tended to be very practical and preferred to leave the session with a lesson plan which they could use as they teach their students. In short, they had reservations concerning the instruction of electrical theory to their students.

A working knowledge of electrical theory is necessary to teach electricity. Even the instructors who had some previous knowledge of electrical theory still benefitted from a good review. Their knowledge of common switching situations and electrical safety was usually sound. They generally needed instruction about confinement wiring practices, the use of heat pumps, and electrical power transmission. The instructors generally were unaware of the importance that electrical power suppliers placed on electricity instruction in the high school.

Instructors responded quite favorably to the course. Approximately 180 agriculture teachers participated in the course. The instructors, although traveling several miles in some cases to the location, were seldom late for class. Evaluations of the course revealed that the field engineers and guest speakers were well received. Favorable comments have been received by other university professors about the electricity in-service course.

Summary

Not one, but several groups have developed and promoted continuing education in agricultural electricity for state agriculture teachers. The state FEC, the University, the state Department of Elementary and Secondary Education, and the Agriculture Teachers have worked together to make this effort possible. The instructor for the course was the university professor who coordinated the activity. He was assisted by the state FEC field engineers and other appropriate university personnel. A total of eight four-hour sessions were provided (32 contact hours). Much of the success of the course can be attributed to the fact that the instruction was conducted off campus rather than requiring the instructors to take the course on campus. Also, each of the sponsors involved in delivering the course were committed to continuing education in agricultural electricity.

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Results of the 1989 NACTA Judging Contest Held at Lake Land College, Mattoon, IL On April 20-22, with 36 Schools Participating

Horses (overall)

Junior College Division

High Teams	High Individuals
1. Black Hawk East	Arlene Debernardi, Illinois Valley
2. U.M. Crookston	Tim McCloud, Black Hawk East
3. Illinois Valley Community College	Melissa Langerad, U.M. Crookston

Senior College Division

1. Purdue U.	Jennifer Bricker, S.W. Missouri U.
2. S. W. Missouri State U.	Missi Weeks, Purdue U.
3. U. W. River Falls	Jeff Pendleton, Purdue U.

Livestock Judging

Junior College Division

	Beef
1. Black Hawk East	Candace Plett, Hutchinson, Comm. Col.
2. Hutchinson Comm. Col.	Mike Stanek, Black Hawk East
3. Joliet Jr. College	Jeff Hallowell, Black Hawk East
	Swine
1. Black Hawk East	Mike Stanek, Black Hawk East
2. Butler Co. Comm. Col.	Rick Crump, Black Hawk East
3. Hutchinson Comm. Col.	Marty Miller, Butler Co. Comm. Col.
	Sheep
1. Hitchinson Comm. Col.	Mike Stanek, Black Hawk East
2. Black Hawk East	Jeff Stauffenecker, U.M. Crookston
3. Illinois Valley Comm. Col.	Ted Vinson, Danville Area C.C.
	Overall
1. Black Hawk East	Mike Hanck, Black Hawk East
2. Hutchinson Comm. Col.	Ted Vinson, Danville Area C.C.
3. Joliet Jr. College	Candace Plett, Hutchinson Comm. Col.

Senior College Division

	Beef
1. Western Illinois U.	Marty Sneath, Fort Hays State U.
2. Fort Hays State U.	Kyle Wakefield, U.W. River Falls
3. Middle Tenn. State U.	Carla Davis, Fort Hays State U
	Swine
1. Western Illinois U.	Troy Tuggle, Western Illinois U.
2. Sam Houston State U.	Ann Smith, Middle Tenn State U.
3. U.W. River Falls	Mike Colby, Murrary State U.
	Sheep
High Teams	**High Individuals**
1. Western Illinois U.	Troy Tuggle, Western Illinois U.
2. Fort Hays State U.	Lyle Whitaker, S W Missouri State U.
3. Sam Houston State U.	Rosemary Forbes, Fort Hays State U.
	Overall
1. Western Illinois U.	Troy Tuggle, Western Illinois U.
2. Fort Hays State U.	Mary Sneath, Fort Hays State U.
3. Sam Houston State U.	Kyle Wakefield, U.W. River Falls

Livestock Evaluation (overall)

Junior College Division

1. Black Hawk East	Brian Thiel, Hutchinson Comm. Col.
2. Hutchinson Comm. Col.	Rod Stahl, Black Hawk East
3. Danville Area Comm. Col	Jeff Hallowell, Black Hawk East

Senior College Division

1. Illinois State U.	Damon Deese, Middle Tenn State U.
2. Sam Houston State U.	Brian Kindschi, U.W. River Falls
3. U.W. River Falls	Jeff Arseneau, Illinois State U.

Agricultural Mechanics

Junior and Senior College Division Combined

1. Wabash Valley Comm. Col.	Alan Krauss, Hutchinson Comm. Col.
2. Illinois Central U.	Devon Hess, Illinois Central U.
3. Hutchinson Comm. Col.	Danal Smith, Hutchinson Comm. Col.