An Interdisciplinary Approach To Teaching Agricultural Mechanics

RICHARD L. HOFFMAN, Chemistry Instructor
MILTON RENAUD, Agricultural Mechanics Instructor
Illinois Central College – East Peoria, Illinois 61611

The 1968-1969 academic year at Illinois Central College saw two faculty members from different divisions cooperate in developing what we think is an unusual approach to teaching the technical aspects of agricultural mechanics. In keeping with our philosophy of giving all students the most comprehensive treatment of subject matter possible, we embarked on a trial program of voluntary interdivisional teacher exchange between our Agriculture and Science divisions. Our purpose was to supplement course material in Welding, Hydraulics, and Gas Engines, by allowing a science teacher to treat topics of pertinence and interest that were not normally emphasized in standard technical textbooks.

We accomplished this end by exploiting the cooperative enthusiasm of the instructors in agricultural mechanics and chemistry. Our chemistry teacher, who also teaches a physical science course for non-science majors, wanted to deepen his understanding of practical mechanisms and processes that occur in everyday life so that he could better explain them to his regular classes in chemistry and physics. It became evident to him that such training possibilities already existed within our institution.

Sensing an opportunity to learn while teaching, the science teacher actually joined classes of students in the areas to be supplemented. The agricultural mechanics instructor introduced him as a teacher of physical science who was interested in their course of study and asked that the students cooperate in helping him along.

Our teacher-student dressed in coveralls and participated in laboratory sessions wherein everyone dismantled and repaired engines, overhauled hydraulic devices, and welded metals. All this was accomplished with the watchful participation of the agricultural mechanics instructor. As practical realities of the work appeared in the laboratory, the science teacher explained the hows and whys. Thus, laboratory and lecture became a unified learning experience beneficial to all concerned.

For example, in welding class, students are taught to pay heed to electrode polarity when welding with a D. C. unit. The science teacher explained metallurgically why such attention is necessary. He did so by discussing current flow theory and the arc temperatures derived therefrom. Laboratory discussions included other topics such as composition of electrode coatings and fluxes. Hazards of ultraviolet emissions and of vapors from arc decomposition products were pointed out. When attention shifted toward oxyacetylene processes, students were treated to demonstrations of metal combustion.

In hydraulics class the science teacher explained the physics of hydraulic machinery and the method of calculating mechanical advantage. He discussed the chemical and physical composition of hydraulic fluids, hoses, and seals. All calculations regarding hydraulic devices were performed relative to an actually available piece of equipment.

The gas engines class provided ample opportunity to discuss oxidation of hydrocarbons relative to fuels and lubricants. Octane numbers were treated by comparing gasoline to exotic fuels such as alcohol and nitromethane. The physics of carburetors and superchargers was dealt with as actual devices were dismantled. Lubricant additives, structures, and applications were examined in relation to the chemical and physical stresses placed upon them.

At every possible opportunity theoretical hows and whys were tied to practical observations in the laboratory. Students benefited from their opportunity to understand each teaching tool from a point of view that supported practical with theoretical. Our science teacher benefited from his opportunity to supplement his understandings of theory with practical experiences. He also discovered the stimulating challenge that comes from teaching students with which he would otherwise have little encounter. His efforts to put science into the very practical field of agricultural mechanics produced new descriptions, approaches, and teaching techniques that were helpful to him in the formal areas of chemistry and physics.

The product of our effort was a group of students with increased understanding of their subject matter and a teacher with an appreciation of another field of endeavor. Perhaps even more important were the attitude changes wrought among the participants. Students met a teacher who wanted to learn as well as to teach and who was appreciative of their cooperation as he learned. Teaching a teacher was a delightful experience that made the students eager to display their competence.

Successes that this approach have enjoyed are doubtless related to having a teacher join classes of students *as a student*. While the students and their "classmate" came to know each other, an atmosphere of free conversation of enlightening proportions was stimulated. They recognized that this science teacher was interested in them and in the dignity of their chosen field. Their teachers had cooperated with each other in an effective way that surpassed any guest lecturer approach.

We attempted to unite the apparently different fields of agricultural mechanics and physical science in a meaningful way. In so doing we found an approach that brings the teacher closer to the student in a less formal way to achieve greater understanding of subject matter. Enthusiastic student and teacher response indicates the success of our experiment.

Techniques For Building Teaching Equipment In The Laboratory

L. ROLAND DOERSCHUG
Agricultural and Technical College, Alfred, New York

This paper No. 69-556 was presented at the 1969 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois.

In this day of innovative teaching there is an urgent need for demonstration and laboratory equipment which can be used in agricultural engineering courses. The specialized needs of this area makes for a limited market; therefore, very little commercial equipment is available and thus it must be built at the local campus. This paper will offer a general procedure one can follow in order to build effective teaching equipment.

The steps in selecting and possibly building effective teaching equipment are as follows:

1. Determine type of equipment needed.
2. Demonstrations desired.
3. Ascertain commercial availability.

If you elect to build the teaching device then the following steps are in order:

4. List components needed.
   a. purchase items.
   b. parts available in department, either as parts of

outdated equipment or new components not being used.
5. Secure price quotations and order the parts.
6. Build the teaching equipment.
7. Try it with students.
8. Develop the software to use with the equipment.
9. Improve the teaching equipment.

Late model machinery and tractors are not always available to the college instructor. If available, there are usually limitations on how much and in what manner the equipment may be used. When teaching troubleshooting procedures, one hesitates to put any component out of adjustment and then let students determine the problem because of the risk of damage.

The author teaches courses in tractor electrical systems, hydraulics, and transmissions. These courses are primarily for students who will work as farm machinery mechanics, partsmen and dealers. Modern tractors have sophisticated electrical systems and it would require a considerable expense to have such a tractor on hand to use. Furthermore, the chances of damaging the electrical components, burning the wiring harness or setting fire to the tractor are high. The Problem Simulator for Tractor Electrical Systems was designed by the author to reduce or limit the amount of damage.

A modern tractor electrical system was needed which could be programmed to simulate problems the student can find using the proper electrical test equipment. Also, this unit was to show several electrical devices which are peculiar to tractor electrical systems. A list of the problems the Problem Simulator should show was developed and are shown in Table 1. Table 1 also shows the switch positions to simulate the various problems on the actual unit. At the time this unit was first built, there were only two commercial units available and these were primarily for automotive electrical systems. Furthermore, the price was too high in comparison with the cost of building the unit; therefore, it was elected to build the unit.

Table 2 shows the components which were needed to build the Problem Simulator. Items No. 1, 9, 17, 22, 24, and 27 were available in the department as surplus. Items No. 2, 3, 12, 14, and 15 were purchased from the Delco-Remy Division of General Motors Corporation. Delco-Remy has an excellent sales policy available to educational institutions desiring to purchase electrical components for classroom use. Many other companies have similar policies. The remaining components were purchased locally from a farm machinery dealership and an auto parts supply.

Pictures of the Tractor Electrical System Problem Simulator are shown in Figures 1 thru 4.

TABLE 1
TRACTOR ELECTRIC SYSTEMS PROBLEM SIMULATOR

Unit Affected	Switch	Position	Problem
Alternator	1	Up	Normal
		Open	Field resistor not in circuit
		Down	
Alternator	2	Up	Normal
		Open	AC Indicator light not in circuit
		Down	
Indicator Lights	3	Up	Normal
		Open	AC and Oil Indicator lights dim – not connected to switch
		Down	
Gauges	4	Up	Normal
		Open	No ground fuel sender
		Down	Poor ground fuel sender
Generator	5	Rear	Normal
		Open	Broken lead in DC field
		Front	Grounded lead in DC field full output
Alternator	6	Rear	Normal
		Open	Broken lead in AC field
		Front	
Regulators	7	Rear	Normal
		Open	Regulators not grounded
		Front	Poor ground
Gauges	8	Up	Normal
		Open	No ground – fuel and oil gauges Oil sensitive to fuel level
		Down	
Ignition Coil	9	Left	Normal
		Open	Resistor open
		Right	Resistor shorted
Lights	10	Up	Normal
		Open	Broken wire in harness to flood light
		Down	Bad connection between switch and light
Lights	11	Up	Normal
		Open	No ground – rear light flashes
		Down	Poor ground
Ignition	12	Rear	Coil leakage
		Open	Normal
		Front	Condenser leakage
Ignition	13	Rear	Normal
		Open	Condenser Series Resistance
Ignition	14	Rear	Normal
		Open	Bad distributor ground
Ignition	15	Rear	Normal
		Open	Coil Disconnected
		Front	Coil Reversed

TABLE 2
COMPONENTS FOR PROBLEM SIMULATOR

1. Variable speed motor – one hp or more to drive the generator and alternator.
2. Alternator and regulator
3. Generator and regulator
4. Alternator field resistor
5. Indicator lights for generator, alternator, and oil pressure
6. Ammeter
7. Oil pressure switches for hour meter and indicator lights
8. Electric sending units for oil pressure and fuel gauges
9. Hour meter
10. Fuel and oil pressure gauges
11. Ignition switch
12. Neutral start switch
13. Starter with bypass ignition circuit
14. Ignition resistor
15. Ignition coil
16. Distributor
17. Motor to drive distributor
18. Spark plugs
19. Circuit breaker for lights
20. Light switch
21. Two headlights
22. One rear work light
23. Rear red light
24. Flashing fender light with flasher
25. Battery
26. Wiring, resistance wire, miscellaneous hardware
27. Board and bench to mount components
28. Switches for the problem simulation

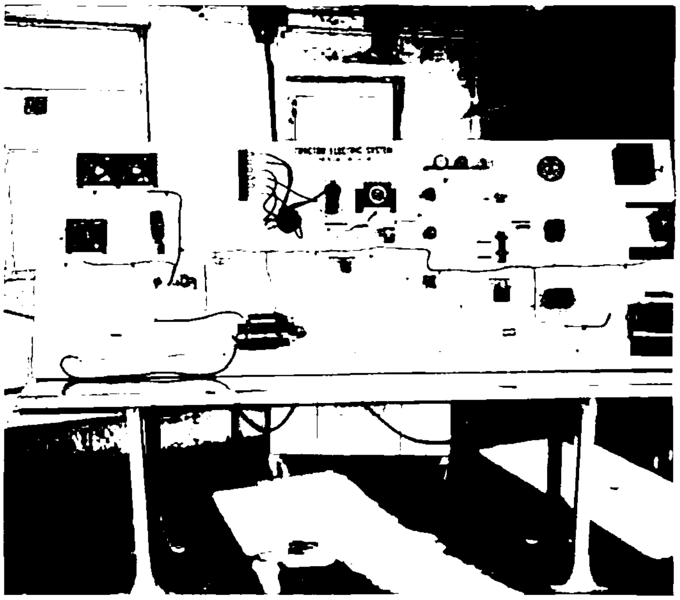

Figure 1 – Front of Tractor Electrical System Problem Simulator

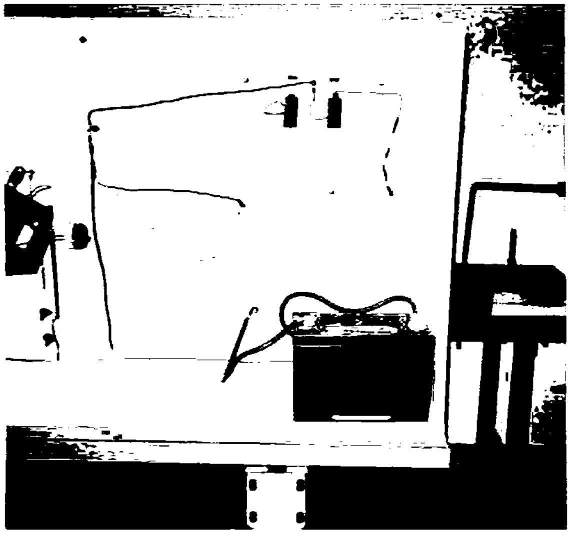

Figure 2 – Rear View showing battery and lighting problem switches

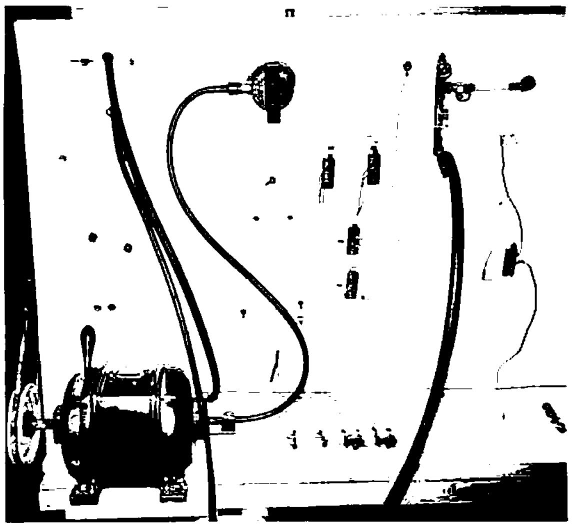

Figure 3 – Rear view showing motor drive for alternator and generator

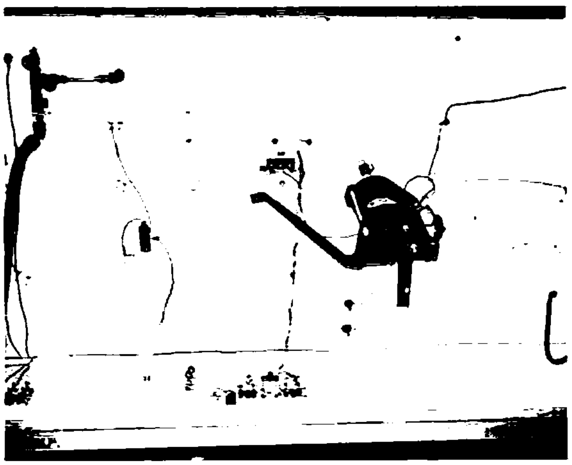

Figure 4 – Rear view showing distributor drive motor

After building the unit, it will probably be easier to use it as a demonstration unit until you are able to develop the exact methods you desire for its use. Probably the hardest job one has is to develop the laboratory exercise or software needed for the students to use the unit to its best advantage. Also, as the unit is used, new problems to be simulated will be developed.

Other units which have been built by the author are a hydraulic demonstration stand and a hydrostatic transmission and axle demonstration stand. The hydraulic demonstration has either a 10 gpm gear type pump or a 5 gpm piston pump as a source of hydraulic power. These are powered by a 7½ horsepower single phase motor. Many valve types and actuating devices can be demonstrated as well as trouble-shooting procedures with this unit. At the present time, a backhoe control valve bank is being adapted to give good practice in troubleshooting the control system without the inconvenience of working inside a tight backhoe main frame. Pictures of the above units are shown in Figures 5 and 6. The hydrostatic transmission stand was built to demonstrate the following:

1. transmission operation.
2. testing methods.
3. the action of a differential.
4. disc type brakes.
5. transmission losses.

The anchor devices for the disc brakes are to be equipped with strain gauges to be able to read the output torques at each rear wheel. The transmission stand is shown in Figures 7 and 8.

The above two demonstration stands also demonstrate very effectively two large horsepower single phase motors and their special controls. These motors are likely to be found in farm applications where high horsepower is needed but three phase power is not available.

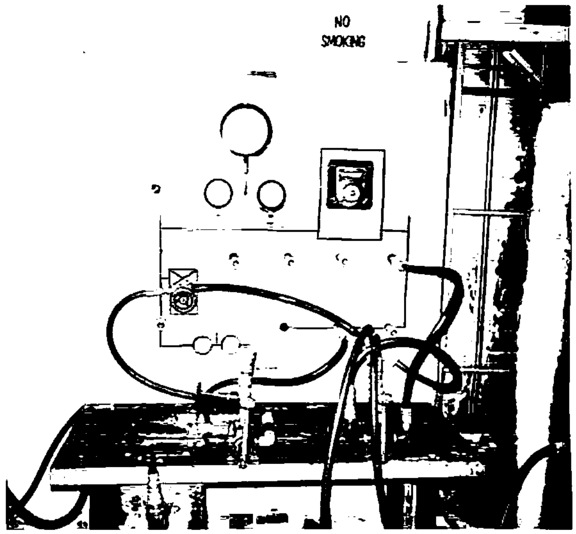

Figure 5 – Hydraulic Demonstration Stand

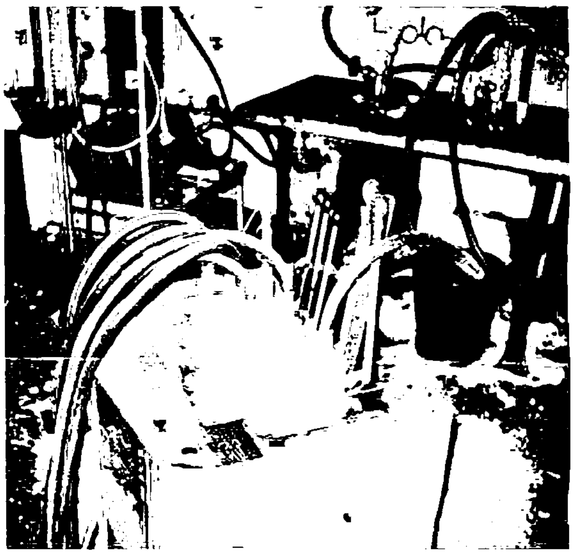

Figure 6 – Backhoe Control Valve with Power Unit in background

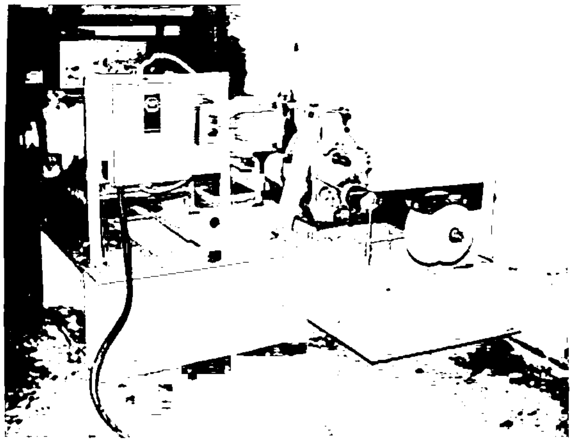

Figure 7 – Front view of Hydrostatic Transmission and Axle Stand

Figure 8 – View of Transmission Stand showing Disc Brake used to measure torque

Building your own laboratory equipment can be a time consuming but rewarding experience. Students respond to any equipment which makes the concept you are trying to get across easier to visualize. As long as there are specialized areas for which teaching equipment must be built, the instructor will be called upon to build some of his own equipment.

The Present Condition Of Higher Education – A Quotation

HOWARD R. BOWEN, Claremont Graduate School

The following is a quotation from an address by Howard R. Bowen before a luncheon meeting of business leaders in Dallas, Texas sponsored by the Council for Financial Aid to Education, Inc.

Dr. Bowen was formerly president of the University of Iowa and has recently been named president of The Claremont Graduate School, Claremont, California.

"It is no secret that higher education has been in a turbulent period. Some of the stresses in our society – those associated with racial strife, poverty, the war in Viet Nam, the overemphasis on material values, and the oppressiveness of large organizations – have been reflected on the campus. In addition, young people of the present 18 to 25 generation, whether in college or not, have been struggling for adult status and adult freedoms. The outcome of these two sets of forces has been varying degrees of unrest on the campus. The universities have been trying to meet these new conditions and pressures. As yet they have satisfied neither the more militant students who want faster change nor many members of the public who want to continue restraints on the young and who are fearful of open discussion of unorthodox or radical ideas. The universities in recent years have been caught in the middle, and have been subject to criticism, and sometimes abuse from two directions.

"The colleges and universities at this time need special understanding and moral support from the public, from donors, and from political leaders. There are many persons today who would threaten the precious freedom and autonomy of the universities by imposing loyalty oaths, restrictions on freedom of thought and speech, control over what is taught and what is studied, supervision over the selection of faculty and students, and detailed control over internal budgets. There are also some – both private donors and public legislators – who would withdraw financial support as a kind of punitive measure. And unfortunately people are sometimes rather undiscriminating in that they blame the University of Texas, or Rice, or the University of Iowa for what may have happened at San Francisco State or Columbia. For those who are critical of higher education today, I would like to offer several thoughts.

"First, the impression of higher education presented in the mass media emphasizes disorders and conflicts. Disorders have indeed been disastrous at three or four institutions in California and New York, and have been mildly troublesome at many. However, the plain fact is that disorderly conduct is rare and that the overwhelming majority of students and faculty, 99 percent at least, at most institutions, certainly including the University of Iowa, are performing creditably by any reasonable standard. Indeed, some of the disorder is fomented by persons who are not students at all, but hangers-on. The students with few exceptions are orderly, hard working, morally upright, idealistic, committed to learning, and dedicated to the advancement of American society. No younger generation has ever seen eye to eye with its elders, and this generation is no exception. But in morality, idealism, honesty, and hard work they are superior to any previous college generation and superior to any other major segment of our society. They are far ahead of my own college generation. They are not perfect; some of them make mistakes; some of them are rude and unkempt; sometimes they do and say stupid things. But who doesn't? To indict the whole present generation of students and young faculty – as some are inclined to do – is grossly unfair and irresponsible.

"To those adults who criticize the college generation I would say: Remember that these young people are your sons and daughters and mine, not some abstract collection of people the universities have gathered together. These young people are the way they are not because of what the colleges and universities have done, but because of what their families, their communities, and American society have done. But in fact the current crop of college students is in no sense degenerate. They are on the whole admirable young men and women.

"Second, the established colleges and universities are outstandingly successful in carrying out their mission of education, research, and public service. They have never been more creative, or more stimulating, or more effective in serving society. American higher education is the envy of the entire world. By any criticism – ability of faculty, standards, teaching effectiveness, research and scholarly accomplishment – American colleges and universities are vastly superior to the institutions of ten, twenty, or fifty years ago.

"Third, the universities of America are today woven more closely into the fabric of our society than ever before. Our economy, our government, our military strength, our