Learning Partnership

(Continued from page 10)

include attention to both characteristics of process and partners (Karls et al., 1992).

Desired characteristics of the partnership process include:

1. Written statement of common goals that is clear and concise and that is recognized and developed cooperatively.
2. Assessment of the talents and resources each partner possesses and is willing to commit to the partnership.
3. Provision of sufficient time and in-service training to plan, sustain, enhance, and evaluate the partnership.
4. Cooperative effort involving all key players that utilize the talents of the partners.
5. On-going communication that is inclusive of all individuals and institutions in the partnership.
6. Sharing of responsibility and accountability.
7. Periodic evaluation of the partnership process.
8. Celebration of successes.
9. Identifying new possibilities for future work among partners.

Desired characteristics of the learning partners include:

1. Belief in ability to bridge different cultures among partners.
2. Evidence of mutual respect and trust among partners.
3. Realistic expectations of the partnership, often built from small successes. (pp. G-47-48)

Partnerships thoughtfully planned and executed can raise the energy and resources for an agriculture program, no small matter in these times of funding constraints. Attention to the desired features, needed intensity, motivations, and functions of the learning partnership can result in a comprehensive portfolio of hard working and productive partnerships serving the unique needs of a program. The "fourth power" in learning partnerships in gained by investing in all four of the potential partner categories — reaping their benefits to improved learning by focusing on good process and partner principles.

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About the Cover

The sciences of food, fiber, agriculture, and renewable resources have, traditionally, been viewed as applied disciplines related almost exclusively to farming. The result was the establishment of a food and fiber system unparalleled around the world. However, it has also resulted in the agricultural industry being considered the world's greatest polluter, the most irresponsible polluter, and an irresponsible user of natural resources. This belief has stemmed from a changing society that has little regard for the food and fiber system and a great deal of suspicion about agricultural products. It is time to change. The future success of the food and fiber system depends on how we, as agriculturists, collaborate with all disciplines of education. Whenever people understand the food, agriculture and renewable resource system, there is at least a chance to develop a more positive perspective of the importance of this system. The time for collaboration is now!

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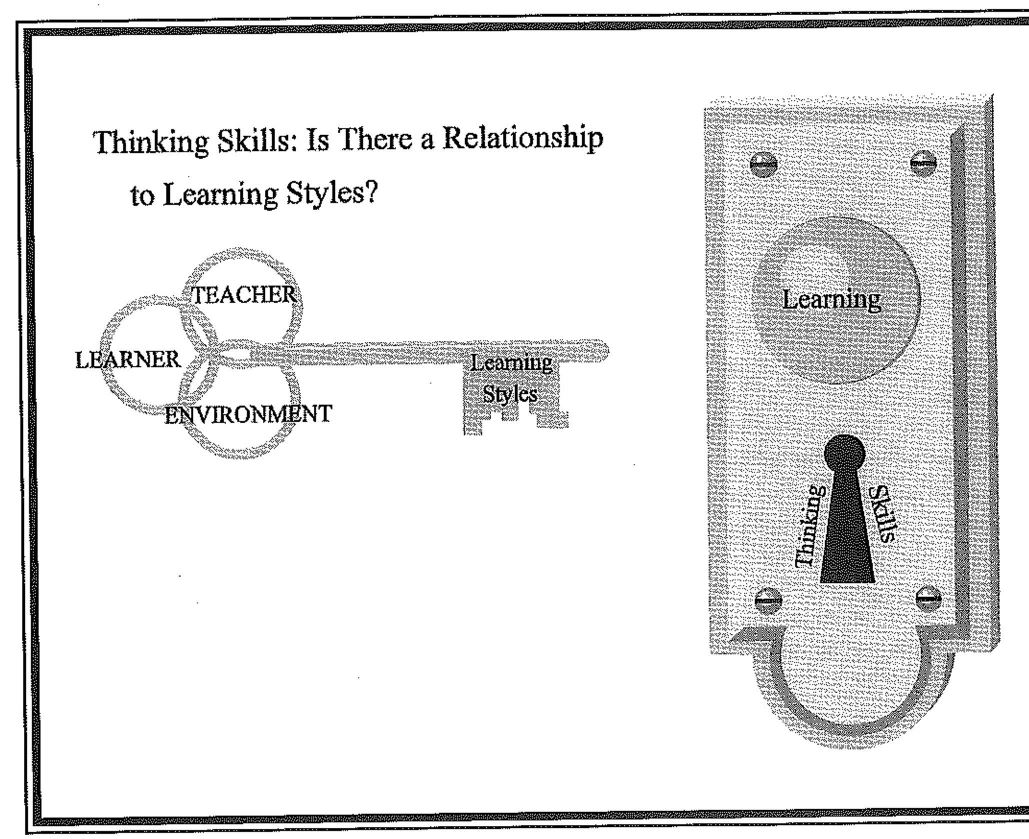

Cognitive Levels of Teaching and Learning

THE AGRICULTURAL EDUCATION MAGAZINE

December, 1995 Volume 68 Number 6

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The $20,000 Question

By M. Susie Whittington

Dr. Whittington is an assistant professor of agricultural and extension education at Pennsylvania State University, University Park.

"The cost of attending some of America's colleges has now soared to more than $20,000 a year.
(Anderson, 1992)

Flashy and slick, the brochure alluring students and their parents to spend $20,000 boasts that "students who attend All-World-U [call it any university you wish] have the benefit of encountering excellent teachers in every department".

"Excellent teaching" appeals to undergraduate students and their parents alike. This clientele would certainly not find the same degree of attraction to, "you will encounter 'renowned researchers' or 'profound philosophers' or 'prolific writers' or 'gifted grantspersons' in every department". Excellent teachers sell universities to prospective undergraduates and their parents. So, just what is the quality of teaching that our students receive for $20,000?

Before I can answer that $20,000 question, I have to develop a model for assessing excellent teaching. That's not easy given the numerous variables involved and the interactions of each. But, let's spend this issue zeroing-in on one variable: *are professors challenging students to think?* Can studying this variable move us toward developing a teaching assessment model, and thus, take us closer to that $20,000 answer?

A Decade of Questions

In the past 10 years a heavy emphasis has been placed on the importance of effective thinking as it relates to success in school, thus ultimately, success in life. Public press articles, such as those reported in the *New York Times*, have stated, "public schools have discovered the importance of critical thinking, and many of them are trying to teach children how to do it" (Hechinger, 1987, p. 27).

The power to think and solve problems should be the learner outcome desired by professors. Many educators agree with Meyers (1986), who stated, "It is increasingly important that students master the thinking and reasoning skills they need to process and use the wealth of information that is readily at hand..." (p. xii). Resnick (1987) added, research shows that many components of thinking can be effectively taught.

American educators, however, have not been singled-out as exemplary models for teaching thinking. McKeachie (cited in Joscelyn, 1988) contended, "Everyone agrees that students **learn** in college, but whether they learn to **think** is more controversial".

In This Issue

I believe we are surrounded by educators in America who do challenge students to think. Professors like Steve Cooke and Marc Klowden at the University of Idaho have earned a reputation for the challenges they offer their students. Are questioning strategies important for increasing the cognitive challenge in our classrooms? If so, Steve Cooke has a "corner-on-the-market' in his agricultural economics class.

Is creativity an essential motivating force for encouraging students to think at higher cognitive levels? I think Marc Klowden offers keen insights concerning creativity in his entomology classroom. Lately, have we had our students asking "why?" Is asking "why" a necessary component for developing thinking skills? Sam Custer believes we should keep students hungry for "why" by capitalizing on the strengths of problem-solving teaching.

Does a teacher's learning style play a role in the approach taken to challenge the students in class? Does a student's learning style limit and/or enhance the cognitive activity that can be achieved during class? If so, what strategies can be implemented to overcome potential barriers influenced by learning styles? Authors Kotrlik, Harrison, and Handley and authors Torres and Cano share expertise concerning the relationship of learning styles and cognitive processes.

In this issue, as we explore enhanced thinking through excellence in teaching, let's reflect on the beauty of teaching agriculture — a subject matter couched in a schema, which, together, work cooperatively and naturally in affording students opportunities to reach the highest level of cognition. L.H. Newcomb very succinctly re-visits the genius in the agricultural education model that captures the essence of teaching thinking skills to students.

Summary

While our understanding of the complexity of thinking is limited, and we have many more questions than answers, we know enough about thinking to justify the intent to improve some aspect of it through teaching that focuses specifically on effective ways of enhancing the

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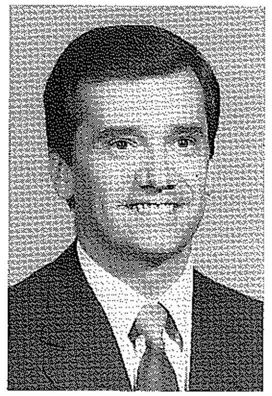
The Genius of the Agricultural Education Model for Nurturing Higher Order Thinking



BY: L. H. NEWCOMB

Dr. Newcomb is the associate dean and director of academic affairs for the college of food, agricultural, and environmental sciences at The Ohio State University, Columbus.

The need to have students graduate with the demonstrated capacity to think at the higher levels of Bloom's taxonomy is more urgent than ever. The nature of the world we live in demands it. Given the pace of technological change and the unabated explosion of knowledge, it is fruitless to try to focus on teaching facts, for this is guaranteed to be a losing proposition.

Agricultural educators are lucky. The fundamental precepts which undergird the agricultural education program are steeped in a genius which is predisposed to facilitating learning at the higher levels of cognition.

Elements of the Genius of the Agricultural Education Model

Some might ask what is meant by the assertion that agricultural education programs contain precepts which form a foundation of genius for the program. There are a number of elements of agricultural education programming which are really imbued with strokes of psychological genius which are so robust that they all but guarantee success if they are even partially drawn upon.

Use of Real-Life Activities as Organizers

The agricultural education model is famous for its insistence that the curriculum grow out of real needs of the community and the students. It is commonplace to have instruction from curriculum development, to lesson delivery, to laboratory assignments (in school or at home) which is organized around projects. The projects vary from animals to plants and from mechanics to business operations.

However, this focus on projects almost always leads to causing students to adopt a holistic approach to their learning. For example, students not only attend to learning how to select an animal but also to all the decisions which follow: budgeting, animal housing, feeding, health, and marketing. Thus, students are actually compelled to "see the big picture". They discover interactions. They must rapidly move from the lowest levels of cognition, i.e., remembering, to comprehension, application, and analysis. Especially if they develop sound "projects," they often must operate at the synthesis and evaluation levels of cognition.

So, the agricultural education way of packaging learning somewhat automatically ensures that students will have to think at the higher levels of cognition. To the extent that instruction in agricultural education moves away from the idea of real-life activities as a basis for instruction, then the gains afforded students for higher order thinking will be jeopardized.

Emphasis on Connecting Theory with Practice

A related strength of the agricultural education model is that teachers are known for their insistence on relating theory to practice. Application is a watch word. This close connection of theory with practice also enhances the likelihood that students will learn to operate at the higher levels of cognition.

Most of the approaches that teachers use to ensure application naturally require the learner to master the comprehensive level of cognition and almost certainly the application level as well. Quite often teachers design problems and other application exercises that require students to demonstrate their ability to operate at the analysis level.

Use of the Youth Organization (FFA) as an Organizer

Some would contend that the FFA is the crown jewel among the gems of genius undergirding the seemingly routine aspects of the agricultural education model. Too often, most fail to remember and value the fact that the chief reason for adding youth organization activities to the agricultural education model was to instill in the program an intentional opportunity to nurture the self-esteem of every student who enrolled. A careful analysis of the psychological constructs which undergird the FFA will reveal that the organization has enormous built-in psychological features only waiting to be harnessed by skillful teachers.

The array of incentives prompt students to action. In carrying out such action, students must think—they must go beyond recall and application; they must analyze. Very often they must evaluate (e.g.: program of activities planning, judging, community service projects, and carrying out goals of committees). Then there are a variety of leadership experiences which

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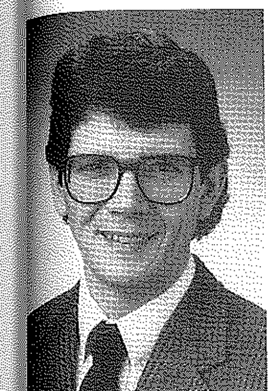
Effective Use of Discussion Method Teaching



BY: STEPHEN C. COOKE

Dr. Cooke is an associate professor in the department of agricultural economics and rural sociology at the University of Idaho, Moscow.

"The classroom discussion is predicated on the fact that the printing press has been invented and, therefore, that the teacher need not function as a high priest who reads the sacred scrolls to the unlettered."
(Schmid, 1978)

Let me begin with a confession. I have a problem with the Socratic Method. The discussion method of teaching is often referred to as the "Socratic Method". For example, as a graduate student, I had three professors who asked questions in class in order to stimulate discussion and called their approach the "Socratic Method". To explain why I think the discussion method of teaching is both different from and an improvement over the Socratic Method, I will apply Bloom's (1956) levels of cognition of analysis, synthesis, and evaluation to compare and contrast the two approaches. My goal is to make the case for the discussion method as *a way of thinking* rather than a technique of teaching. For me, the assumptions associated with this way of thinking are a prerequisite to effectively using the discussion method of teaching.

Plato describes a teaching method used by Socrates in which he would ask his students a series of questions. The purpose was to elicit clear and consistent thinking from the students as they reasoned from the parts to the whole. Through this process of induction, Socrates thought that his students could make explicit the "Truth" that he assumed to be implicit in and knowable to all rational people.

Anytime I have used a series of leading questions to get a student to state what to me was an "obvious truth" in my agricultural marketing class, I have found the experience to be as frustrating to me as it is numbing to the students.

Professor: "What did Lipsey and Lancaster say about the difference between economic constraints that are 'in the nature of things' and other constraints, such as policies relating to taxes and subsidies?"

Students: (dazed silence).

Professor: "Try looking in the first paragraph in the second section".

Students: (quietly reading in silence).

Professor: "A hint—look at the sentence that begins, 'In general'".

Students: (searching in silence).

Professor: "Would anyone care to read that sentence?"

Students: (glancing at one another, one student begins reading slowly and quietly, "In general,...").

This approach reminds me of a determined calf I once tried to show at the county fair—not the stuff for articles on teaching excellence, except, perhaps, by negative example.

So what is the problem? I think there are three problems with the Socratic Method. First, I think there is no such thing as the "Truth". Warren Samuels says that the opposite of a small truth is a falsehood and the opposite of a big truth is another big truth. If I am trying to teach "big truths", then there is likely to be more than one "big truth" to consider.

Second, in discovering a relative truth, deduction is as useful as induction, though neither is definitive. Hume's (1967) paradox suggests that both induction and deduction require a leap of faith. With induction, the leap is the assumption that the specific holds for the general. With deduction, the leap is the assumption that the initial conditions are true.

Finally, I do not believe that a fully formed truth exists implicitly in each of us to simply be unveiled. If chance favors the prepared mind as Pasteur (1980) suggests, then there is much intellectual preparation to do first. C. Wright Mill (1959) stated that scholarship is a process he characterizes as intellectual craftsmanship. Through diligent craftsmanship, students build their own window to the world. Some individuals' windows are bigger and clearer than others, but they are self-constructed windows nonetheless. Thomas Kuhn (1970) has documented the craftsmanship →

process in which scientists have so transformed their world view as to produce scientific revolutions.

Thus, I doubt the value of the Socratic Method; it appears to deny the existence of relative truth, multiple paths to knowledge, and intellectual craftsmanship. Therefore, I do not call the discussion approach I use in my agricultural marketing class at the University of Idaho the "Socratic Method". Beyond this, to accept these three conditions requires a teacher to maintain a way of thinking that goes beyond a technique.

The result of this way of thinking is a discussion method that, to me, suggests the following. First, I think that the role of the instructor is to plant questions, to draw out lines of inquiry, to help crystallize ideas, and to demonstrate his/her thinking process out loud. The function of a teacher is replaced by that of a coach, facilitator, and catalyst. I view the instructor as an active listener, a recorder of comments, and a creative organizer of the flow of information and ideas. The instructor tries to reflect back, in a more emotionally neutral way, the enthusiasm and mastery the students are developing toward the subject matter.

I think the students' roles are to practice as a partner in the tasks of analyzing, synthesizing, evaluating, and monitoring the process of discovery with the instructor and other students. Students learn through the senses of sight, sound, and feelings through student paper presentations, role playing, and case studies.

Finally, I think the classroom is a place to model the scientific method of problem definition, theorizing, data collection, results analysis, and conclusion-building. The environment is one that is encouraging, safe, fun, and supports the exchange of ideas. The classroom is a place to pursue the "many truths" in the company of friends.

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The Genius of the Ag Ed Model

(Continued from page 4)

allow (even force) students to operate at the synthesis level. Examples include preparing for public speaking, some aspects of parliamentary procedure, and creating plans for programs like Building Our American Communities.

Through all of these kinds of activities, one's belief in self can be strengthened. Rewards which are pervasive in the agricultural education model of education fuel a sense of worth. When self-esteem is strengthened, people are freed to think—to go beyond the routine and to really apply themselves through higher order thinking.

Summary

Our founders incorporated real elements of genius when creating this model of education that we in agricultural education all too often take for granted. We need to focus more intently on grasping and leveraging the intricacies of the model. We need to make sure we draw on the depth of its richness. Too often we are lazy thinkers, content to rattle off the trite while missing splendid opportunities to find existing ways to nurture our students' abilities to think at the higher levels of cognition. If we use the genius of the model that is in place, our students will be the beneficiaries. ■

The $20,000 Question

(Continued from page 3)

quality of thinking.

Teachers who strive to continually expand their repertoire of techniques and methods to develop in students a wide range of reasoning, creativity, and cooperative abilities will enjoy reading, reflecting upon, and implementing the contents of this issue. Although I have addressed only this one variable in a model of excellent teaching, the variable "enhanced thinking" is *critical* for moving us toward the $20,000 answer: "Yes, students are receiving their $20,000 worth because professors are challenging them to think".

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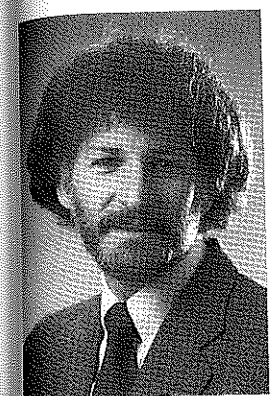
Insects in the Classroom: Using the "Creating" Level of Cognition in Teaching



BY: MARC J. KLOWDEN

Dr. Klowden is a professor of entomology in the department of plant, soil, and entomological sciences at the University of Idaho, Moscow.

It's hard to imagine any child not becoming excited about dinosaurs or insects. Live dinosaurs haven't been used in classrooms for at least 65 million years, but insects can give us a foot in the door, and sometimes all six, as a way of exciting college students and motivating their learning. The childhood fascination with insects is never really lost and can be effectively manipulated to stimulate the learning process.

I teach an introductory course in entomology at the University of Idaho. As one of the natural science offerings in the core curriculum, the course is taken by students across campus in majors as diverse as architecture and zoology. I strongly believe that one of the barriers to learning is the perceived relevance of the subject matter. Students who think that information is simply "academic" and of no use after the course is over will not be as eager to learn as those who take it more personally. Therefore, throughout the course, I strive to demonstrate relevance of subject matter and use the excitement that insects bring, both to my advantage and that of the students.

I begin the course by giving each student her or his own cockroach to take home and look after during the semester. These are not your average cockroaches that are found at home, but are large, slow moving Madagascar hissing cockroaches. I have also come to a reasonable understanding with the university housing office, which is now used to the yearly invasion of animals that housing offices usually try to avoid, that these tropical cockroaches would never become established in buildings as far north as Idaho. Along with the insect, I give students a brief instruction sheet on its general likes and dislikes and how to tell which sex it is. They are first required to fabricate an escape-proof living quarters that provides it with food, water and the proper temperature. After 2 weeks of observation, they write a short paper on what they observed, such as whether it liked bananas or cereal, or when it was most active during the day. The first portion of the course describes the biology of insects in general, and I use their cockroaches as a way of personalizing the information. Now that they have a living thing at home that depends on them for its survival, I believe the students are much more likely to see the relevance of what is presented. For example, when we discuss the molting process, there are usually several students who have watched their specimen molt and are thus able to contribute very enthusiastically to the discussion. When we talk about temperature preferences and adaptations to the environment, students can always add their personal observations to classroom activities. They bring their cockroaches back at the end of the semester but may keep them as pets after the course is over if they like. Students have come back after 5 years or more to tell me they still have a pet cockroach at home.

I have always been fascinated by the feeding behavior of insects. How is it that an animal with a brain about the size of a poppy seed can distinguish different types of food? Indeed, it's very difficult to understand how such a simple nervous system can give rise to the complex behavior patterns that we observe, and make decisions about whether feeding behavior should be expressed. The students have observed this themselves when they see that their cockroach has certain likes and dislikes; but we often tend to anthropomorphize, giving insects the same reasoning powers as humans, sometimes thinking the food preferences of insects are conscious. I have used Hostess Twinkies, a classic example of junk food, to illustrate that it's not necessary to have either intelligence or consciousness to choose food. I give each student their own Twinkie at the beginning of the class period and tell them to try not to think about their feeding decisions. Would it be possible for an animal without consciousness to take advantage of this food? I take the students through the same steps that we believe insects follow when recognizing food. We begin with the outer cellophane wrapper (rather obvious to us as a wrapper because we know what's inside) and compare it to the way we humans must appear to blood-sucking insects: as a wrapper of skin that encloses the

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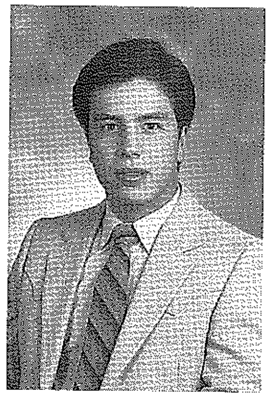
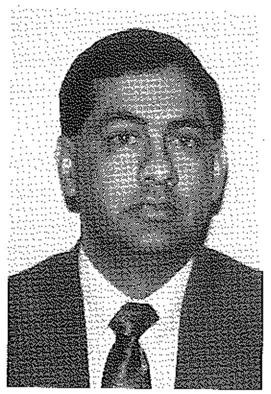
Increasing Thinking Skill Through HOT Teaching





BY: ROBERT M. TORRES & JAMIE CANO

Dr. Torres is an assistant professor of agricultural and extension education at New Mexico State University, Las Cruces, and Dr. Cano is an associate professor of agricultural education at The Ohio State University, Columbus.

What can we teach students that will last a lifetime? Is it the content in our curriculum? Is it the technology that we introduce? Or is it the leadership skills we attempt to develop? While the answers might vary, there is consensus that no educational effort is as paramount as *teaching students how to think.* All you need to do is read any educational report to find references making strong arguments for developing in students the ability to think, make decisions, and solve problems.

The issue of developing thinking skills has been, and continues to be, a major concern for all those who believe in its value. Today, fifteen years after the landmark report *A Nation at Risk* (1983) noted our students' inability to think, we find ourselves asking the same questions we did then. Why? Do we as teachers not know the meaning of higher-order thinking (HOT)? Do we as teachers not know ***how*** to teach higher-order thinking skills? If we don't, why not? Are our teacher education units partly failing in their mission? Or do we just not care?

Why should we as teachers care about developing higher-order thinking skills in our students? Because as Bloom and his colleagues (1956) suggested, as teachers we have the task of preparing students for problems that cannot be foreseen in advance, and what we can do is help students develop the thinking skills that will serve them well in future situations.

Higher-Order Thinking

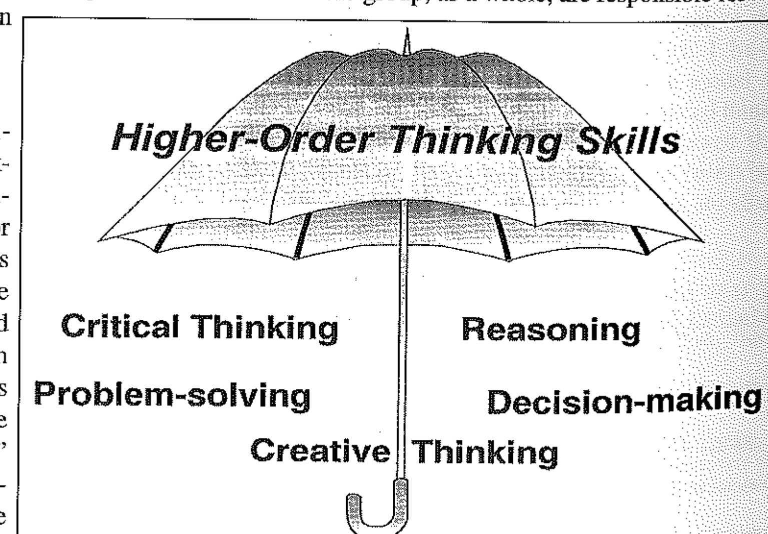
Whether we call it critical thinking, creative thinking, problem solving, reasoning, decision making, or any other term, the end is the same—for students to be conscious of, active in, and responsible for their own thinking and learning. This requires students to do more than recall facts or "just" understand concepts. Students must actively engage in synthesizing and evaluating concepts and principles. So important are thinking skills that all, if not most, schools identify the skill as a major goal for the institution.

Thinking in the Classroom

There are some who resist efforts to improve the quality of higher-order thinking in their classroom. This resistance is in part due to a series of myths. According to Hunter (1991), some teachers believe that: 1) thinking cannot be taught, 2) some students are naturally and irremediably dull, 3) the quality of students is declining and there is nothing that can be done about it, 4) others are teaching "thinking," so it is not an accountable responsibility of their course, and 5) teaching thinking skills is alien to their regular teaching responsibility. Unfortunately, some teachers operate under the influence of these myths. This should not be the case. Teachers need not search far for means of integrating higher-order thinking into their teaching. Here are some possibilities.

Cooperative Learning

Cooperative learning has received much attention in the education literature. Rightly so. It is a structured teaching technique that uses group investigation, peer teaching, and cooperation to encourage student learning. In addition, it teaches the importance of group work by dividing the content and the learning process among members of the group so that individuals and the group, as a whole, are responsible for → the learning. The key components of cooperative learning are positive interdependence, individual accountability, group process, social skills, and face-to-face interaction. For a more in-depth explanation on the key components refer to the article by Bruening (1990) in the September issue of *The Agricultural Education Magazine*.



Higher-Order Thinking Skills encourage students to actively engage in synthesizing and evaluating concepts and principles. *(Figure courtesy of Robert Torres.)*

In structuring cooperative learning situations, the teacher's role involves these basic elements: a) clearly specifying lesson objectives, b) placing students in productive learning groups, c) clearly explaining the cooperative goal structure, d) monitoring students, e) giving specific assignments to each student within a group, and f) evaluating performance (Love & Gloeckner, 1992).

Integrating Curriculum

So important is thinking as an outcome that some educators would suggest teaching a separate course on the topic. However, with a few basic modifications to current practices, the opportunity to integrate higher-order thinking skills into the current curriculum may become routine. How can we transform our current curriculum in an effort to integrate higher-order thinking skills in our teaching?

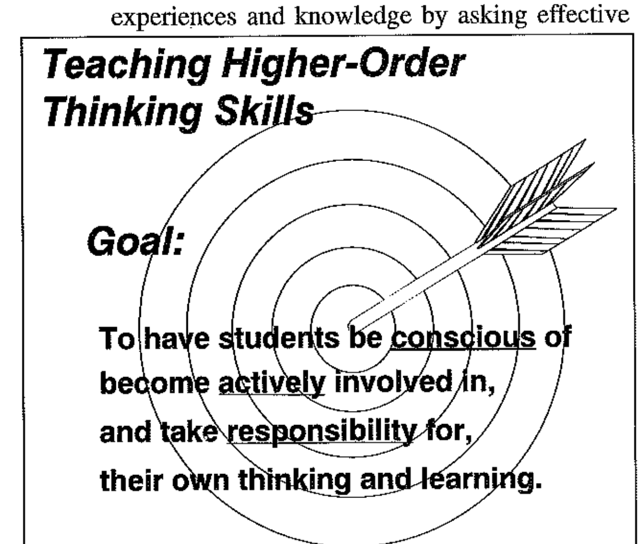
The transformation process involves:

a) restructuring student objectives to include higher-order thinking skills, and ensuring that the process of implementation follows the written objective;

b) ensuring that assignments and homework contain learning activities that appraise, argue, assess, conclude, evaluate, judge, validate, and weigh differing circumstances;

c) in addition to well-developed paper and pencil tests, providing opportunities for various forms of assessing student learning; and

d) challenging students to search out their experiences and knowledge by asking effective oral questions during classroom discourse through probing, and occasionally assuming a "devil's advocate" role.



Cooperative Learning, integrating higher-order thinking skills into the curriculum, and a more constant use of the problem-solving approach to teaching are but a few means by which we can excel at teaching higher-order thinking skills to our students. *(Figure courtesy of Robert Torres.)*

However, it would be foolish to believe that the said practices will occur tomorrow, when instead, tomorrow is the starting point for an effort that transcends time and content.

Problem Solving

Problem solving offers many opportunities for developing and enhancing higher-order thinking skills. From experiencing a provocative situation, to defining the problem, followed by seeking data and formulating possible solutions, and culminating with testing and evaluating the results, problem solving provides an established model for the development of higher-order thinking skills. This problem-solving approach to the teaching model has been advocated in agricultural education in various forms for the past 78 years.

The problem-solving approach to teaching allows for the use of multiple methods and techniques that can be used to promote higher-order thinking in all phases of the agricultural education program. If we as teachers utilize the problem-solving approach to teaching, our students will become adept thinkers.

Summary

Do we as teachers know what higher-order thinking is? Do we know how to teach higher-order thinking skills? The answer to these questions is an absolute "yes." When we view education in a global context, agricultural education classrooms provide a unique opportunity not afforded to other teachers. Our content naturally lends itself to using higher levels of thinking.

Cooperative learning, integrating higher-order thinking skills into the current curriculum, and a more constant use of the problem-solving approach to teaching are but a few means by which we can excel in teaching higher-order thinking skills. However, the bottom line is this: if we don't embrace a personal teaching philosophy that higher-order thinking skills are vital for student success, then all is for naught. It may well be that we just don't care.

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WHY? Practices Used in Vocational Classrooms to Encourage Students to Think

BY: SAMUEL G. CUSTER

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If you will, remember back to when your children were three years old. I vividly can because my daughters always wanted to know "**why**" at that age. Why did they need to sit in their car seats, why the water went down the drain, why you stopped when the light was red, and even why the cows went to the woods during the day. I am sure all of you can remember these times through your children or someone else's. So, we tried to explain why, as difficult as it might have been at times.

What do we do in education at the secondary level? We typically forget to explain "**why**". We get hung-up on lecturing about what happened when, and this is what you need to do because that's the way it is, or because the research says so. When we dealt with three year old's, "because I told you so and that's the way it is", did not work. I believe it does not work with our teenagers either.

In the August, 1995 issue of The American School Board Journal, Willard Daggett expresses that at the turn of the century, our educational system was based on the agricultural society; it then moved to an industrial system. In the industrial system, how did people know when to report to work? Simple. The whistle blew. How did they know when it was time for lunch? Again the whistle blew. How did they know what time to quit? The whistle blew. What did you do if you had a problem at your work station? You took the problem to upper management and let them solve it.

Now, move back to a workplace similar to that of the 1800's based on the agricultural society. On the farm, you knew it was time to get up when work needed to be done. You knew it was time to stop when the job was done. Rather than doing one job, people on the farm did everything. When there was a problem on the farm, what did the farmer do? He **did not** go to the manager—he solved the problem himself or with the help of neighbors. Is this starting to sound familiar? It does to me. It sounds like the workplace today. The farmer was able to solve his own problems because he was a student of the "why's".

It is my belief, that we as educators must make our students stronger candidates for the workplace. We need to return to the agrarian-based educational system. Our students need to be able to determine the who, what, when, why, and how on their own. How can we accomplish this? I believe the answer is simply teaching at a higher cognitive level using the problem-solving technique. We need to abandon the technique of rote learning. In today's changing workplace and with technology changing daily, memorizing tables, planting dates, and page numbers is an obsolete approach. Our students must be able to solve new problems on their own using methods they learned in school.

How do we teach problem solving as a method of dealing with the workplace? By modeling. The problem-solving approach to teaching is a simple model that is applicable in all classrooms and in all situations. Every day of our lives, we are continually confronted by problems of varying difficulty and importance in all areas of our lives. Problem solving or decision making begins when we awake in the morning and continues until we fall asleep at night. However, we are not born with the ability to solve problems or to make decisions. The ability must be taught to us through observation and involvement. In problem solving, the learner is aided to define and limit the problem to find necessary information, interpret and analyze the problem, and be permitted to be a divergent thinker.

What are the results of using the problem solving technique in the classroom? If done properly, students will begin to revert back to their preschool ways of wanting to know why things happen the way they do. Is this good? Yes, I believe it is. We need to work with our students to develop their inquisitiveness. If an instructor tells students that the ideal planting date is May 1, the students and the teacher *need* to explore the concept of why. If a teacher tells the class that we want heavy muscling in the loin and rump area, the students *need* to know why. If a student tells the class that the lab cages *need* to be cleaned daily, the teacher needs to ask them why. ➞

"**Why?**" can be such an annoying request, but we must deal with it, and we must foster its usage. How do we accomplish this, here are some of the approaches I have observed.

- Use real life examples. It will be easier to explore the why's and how's if students have a direct relevancy to what is being discussed.
- Never leave an answer explained with "because that's the way it is".
- Use the problem solving technique in all teaching situations. This will prompt the students to identify the problem and develop a solution.
- Whenever you do any activity, either explain to the students why they are doing the activity or have the students explain why they are doing the activity.
- Develop a technique that best works for the instructor, but avoid rote learning whenever possible.

Robert Sylvester (1994), recommends that schools focus more on metacognitive activities that encourage students to talk about their emotions, listen to their classmates' feelings, and think about the motivations of people who enter their curricular world. For example, the simple use of "**why**" in a question turns the discussion away from bare facts and toward motivations and feelings.

Why examine the way you have always taught? Because students entering your classrooms need to leave with the skills required to solve the problems that have yet to be identified.

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Insects in the Classroom

(Continued from page 7)

blood, which is what the insects are really after. I emphasize that the insect must have evolved sensory receptors that will detect the "wrapper", just as blood-sucking insects are attracted to emanations of carbon dioxide and other odors from our skin. Other factors come into play that cause the insect to continue feeding once the wrapper is penetrated and the food is sampled. To explain why some insects show feeding preferences, we discuss the absolutely shocking admission by some students that they actually don't like Twinkies. Over the course of the hour, we slowly devour the Twinkie, just as an insect might do.

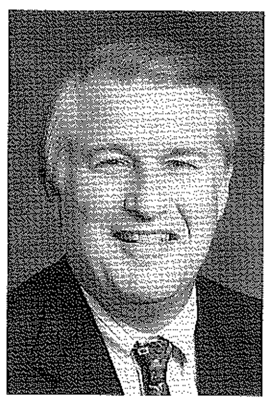
Humans tend to overeat when faced with large quantities of tasty food, even though we know it's not always good for us. Do insects have the same problem in terminating their feeding? Mosquitoes ingest huge blood meals, often 5 times their empty weight. How do they know it's time to stop feeding before they eat too much and burst? To demonstrate how the termination of feeding might occur without requiring consciousness, I show the students a mosquito on a large screen TV as it feeds on my arm under a microscope. It normally withdraws its mouthparts from my skin when its abdomen reaches a certain size. I then show another mosquito in which the nerves that lead to abdominal stretch receptors have been surgically cut. When these stretch receptors detect too much distention, they send a message to the brain that tells the mosquito to pull out. However, in the surgically operated mosquitoes, this message never reaches the brain. Before their eyes, students see the abdomen greatly expand and finally burst. The mosquito continues to feed and blood drips steadily from its ruptured abdomen because the information from these stretch receptors to the brain is lacking.

Many insects recognize individuals of the opposite sex for mating by the use of pheromones, the chemical signals produced by one individual that changes the behavior of another. Other insects use visual or auditory cues to identify potential mates. House fly males recognize females first visually, by their general shape, and secondarily by chemicals in their integument. I demonstrate mating behavior by the house fly in the classroom using shoelaces. When tied tightly and the ends clipped off, the small balls of knotted shoe lace are visually appealing to males, but it is only when these "pseudoflies" are treated with simple extracts of females do the males become stimulated and the beginnings of their characteristic mating behavior. Similarly, male mosquitoes respond to females by the characteristic wing beat frequency she employs during flight. When I insert a tuning fork into a cage of male mosquitoes under a video camera, I can show the entire class the way they vigorously respond when the tuning fork is set to the correct frequency.

It would be difficult to demonstrate any of these phenomena in the classroom with any other animal besides an insect. They provide not only a way to show the responses of living things in a biology course, but they can "push buttons" in our students, generating a great deal of enthusiasm and paving the way to painless learning of some important biological principles. ■

THEME ARTICLE

Thinking Skills: Is There a Relationship to Learning Styles?



By: Betty C. Harrison, Joe W. Kotrlik & Cynthia Handley

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Anyone can learn without thinking, i.e., rote memory. One can put the key in the lock and still not open the door (mind) to learning. It may require a change of behavior to recognize learning has taken place. One must turn the knob for that door to open the mind and extend beyond one's current position. Learning is the result of the interrelationships and action of the key, lock, and door knob as one process.

Learning, Learning Styles, and Thinking Skills

Learning is the gaining of knowledge, information, comprehension, or skill, which is reflected in action, processes, experience, or behavior modification. Developing and implementing an instructional system most appropriate for each student to learn involves time and effort. It requires thinking. Henry Ford is quoted as saying, "Thinking is the hardest work there is, which is probably why so few engage in it". Implementation of a system incorporating thinking skills into a teaching-learning system does support the goals of education. Those goals include impacting attitudes, increasing knowledge, and improving skills. The learning styles of students and the teaching styles of teachers must be in agreement most of the time for a maximum impact on attitudes, gain in knowledge and improved skills.

One of the main philosophies supporting learning styles is that learning should be a pleasant and successful experience for **all** students. While the preferred learning styles of students cannot be allowed to dominate all other considerations, consideration for differences should be accommodated. If indeed one's perception, processing, decision-making, and behavior are all unique to each individual, then it is essential that the instructional plan and delivery address the uniqueness of learners.

Just as there are individual differences in how one perceives and processes information (learning styles), there are also different paths, patterns, and orders in addressing thinking skills. According to Harrison & Bramson (1982), "Most people, most of the time, think about things in only one way. Some people occasionally use two ways of thinking. Very few people ever approach a situation in more than two ways. Each of us has a preference for a limited set of thinking strategies" (p.1). Beyond thinking, there is individual feeling. Based on the work and writings of Gardner (1983), at least seven kinds of intelligence are known. These multiple intelligences act in combination with one another, differing for each person in the peculiarity of the combinations and in ways believed most comfortable for the person.

Thinking skills are *those ways used to make learning meaningful in useful contexts from random information; often they are operationalized as a path, a pattern, or an order.* Some of the many ways to describe thinking skills include: observing, questioning, visualizing, diverging, ordering, prioritizing, classifying, identifying parts, experimenting, recording, predicting, tinkering, explaining, summarizing, synthesizing, and refocusing. McCarthy (1992), in her 4MAT System, established these ways (and more) of describing thinking skills and organized them into four groups: focusing and generating skills; patterning, organizing, and analyzing skills; inquiring, exploring, and problem-solving skills; and, integrating and evaluating skills. She has said "Learning happens as one adds new insights to what one already knows. When a person sees something that connects something that is recognized as an extension of present understanding, learning happens".

Learning styles is a *generic term referring to the way people engage in learning.* It may refer to any number of differences in the way people perceive and gain knowledge (cognition); in the way people form ideas and think (conceptualization); in the way people feel and form values (affect); and, in the way people act (behavior) (Loesch & Marienau, 1990, as cited in McCarthy, 1992). Often, it refers to the perceiving and processing of information, a brain function which may be imbedded in theories from fields of neurology and medicine, psychology, education, business, arts, and humanities (brain dominance, personality, learning, curriculum and instruction, leadership, management, dance and movement and environment). For years people have explored, labeled, and theorized about learning, and in the last decade the publications related to thinking and learning have escalated. Some of the people whose work in theory, research and applications are reflected in higher-order learning include Jung, Myers-Briggs, Mok, Keirsey and Bates, Witkin, Keefe, Gregorc, Butler, Kolb, McCarthy, Barbs and Sassing, Dunn and Dunn, Sherry, Bogan, Bruner, Bateson, Gardner, Harrison and Bramsom.

Reflection, Thinking, Action, and Application

Strategies for enhancing the opportunity for learning through reflection, thinking, action and application may be no different from those practiced by the readers of this publication. However, when used by teachers these strategies are less deliberate than they might be if the perception, process, and products were more thoroughly considered for each learner. Exercises for determining learning styles of individuals are available from the literature and commercial sources. The analysis of learning styles is an attempt to identify how individuals learn more easily and most efficiently. Some individuals learn better by listening, some by action, some by printed word, and others by visualization. Some need field independence, some field dependence, some need to talk things out, some want to know what experts think, some want to take immediate action, and others want to explore the possibilities. Some learners need to have the teacher take the more active role (direct) while others prefer the teacher to be less active (facilitate or guide) in the learning process. Concrete experiences provide more opportunities for creative teaching and learning. Abstract and conceptualization experiences allow for the intellectual and organizational part of teaching.

The relationship of what happens on the street (informal, community) to what happens in school (formal, rules and regulations) incorporates thinking and makes learning meaningful. Choices are often divided into four categories. Perception, or cognition, may focus on 'How do I know,' i.e., whole or part, idea or contexts, abstractly or concretely, field dependent or independent. Processing of information may focus on 'How do I think,' i.e., connections or singleness, random or sequential, splitters or lumpers, extrovert or introvert, privately understanding concepts/experiences or thinking aloud or with others. Motivation, judgment, values, and emotional responses reflect on the affective domain and may answer the question 'How do I decide', i.e., internal or external motivations, please or rebel, involved or neutral, low-key or emotionally charged environment, content or delivery. Incorporated into the cognitive, conceptual, and affective patterns are found behaviors or 'How do I act', i.e., reflective or active, work alone or in groups, reaction by situational or part or whole, random or systematic approach, structure or open ended, same or different environments.

Sample Implementation Strategies

Sample strategies are listed below to assist teachers as they incorporate varied learning styles into their instructional plans. Some teachers may already have implemented similar strategies, in whole or in part. Each teaching strategy is offered only as a guide and is designed to focus on a specific learning style group. Keep in mind, however, that one cannot ignore the level of the student when selecting strategies appropriate for the learner.

Strategy: Discussion. Using the field of (or a specific part of) agriculture as the base from which to work, ask students to determine why the curriculum is important to a segment of the population, the country, or the world. Ask students individually to determine the most important concepts and topics to consider for study over a specified period of time and prepare a reason to defend their choices. Follow with grouping of several individuals (random group or group by learning style, if known) to discuss individual listings to reach a group consensus.

Combine groups as time allows until the entire class is one group and the class agrees (with sound reason) on the critical concepts. The teacher is involved to assure appropriateness and sound thinking as the basis for reasons why the students believe certain concepts are needed. It has been said people cannot deny the learning if they have said it is needed and they have been part of the process. This activity does not mean turning everything over to the student nor is it the way to address every unit or a total program. However, it does mean the teacher values the individual and her/his interest or ideas, as well as extending opportunities for those whose learning style requires an answer as to "why" one needs to know certain information.

Strategy: Outlining. Individuals will engage both left- and right-mode thinking in the process. One must be able to understand the whole passage to be outlined in order to break it into parts of the total outline, as well as to process the parts of the passage to the whole. This reflects on how one analyzes, how one thinks, and the incorporation of both left- and right-modes into whole brain action. The brain is a system which works all together and always in relationship (McCarthy, 1993). This activity provides the student with information related to the concept, and emphasizes the most significant aspects of the concept in an organized, organic manner. It draws attention to important, discrete details. The teacher is involved to ensure that the important information is gained from the text or other materials.

Strategy: Doing. Using whatever materials available (pieces or scraps will do), give students the task of making an address marker for where they live. A reasonable time frame should be established for the completion of the project and allow students to discuss ideas (none are right or wrong, good or bad). Without specifying specifics of what it *should* look like when it is finished, allow students to create their own design, do the construction of the marker, and evaluate it. Students could log their activity and write the specifications, methodologies, problems and short-cuts, as well as significance of the creation for the individual. This opportunity focuses on whole-brain learning and the application of knowledge to skill development and it reflects the affective domain as it determines behavioral outcomes. It provides hands-on activity for practice and mastery as it encourages and provides for tinkering with ideas, relationships, and connections. The teacher can bring closure through discussion and asking students to refocus the process to another application.

Strategy: Problem Solving. Based on a set of established criteria (for sightseeing or to save time or to avoid traffic), consider the concept of traveling from 'X' city to 'Y' city. Students determine the 'X' and 'Y', consider related facts, map the route, and evaluate all the ways to make the trip. Apply this concept to an exercise of problem solving from your curriculum, i.e., electronic circuitry, house design, or feeds for a specific animal. This activity allows the individual to use their personal thinking style to arrive at the same destination. It then gives each individual an opportunity to share their paths so others may know of differences and honor their style. It encourages students to share their perceptions and beliefs. This experience begins with a situation that is familiar to students and builds on what they already know with the teacher guiding students to reflection and analysis of the experience.

Strategy: Possibility Thinking. Use an object from the learning laboratories of agriculture and ask students to extend its use beyond the original purpose. They could interpret/translate the item into an art form, communication tool, musical instrument, etc., using available materials (wood, plastic, metals, glass, etc.). Ask students to give it a name and display their creations for others to view. This kind of activity engages an appreciation of 'another way to view' what may seem very literal, very 'one way' to others. It is another way of knowing, using different kinds of intelligence and creativity. It transforms the concept into an image or experience and provides a metaview, lifting students into a wider view of the concept.

"Children know how to learn in more ways than we know how to teach them." (Ronald Edmunds, ASCD poster). A teacher can address all the learning and thinking styles of students if a quick check is made in the instructional delivery plan to determine if four questions are answered regarding that which is to be learned. Those questions are why or why not (give them a reason), what (facts: teach it to them), how does this work (action: let them try it), and what can this become or what can I make of this (let them teach it to themselves and someone else) (McCarthy, 1980). Thoreau has been quoted as saying "If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music he hears, however measured and far away." Sense, reflect, think, and act to accommodate all learners so that it is a win-win situation for learners and teachers, for schools and communities, near and far.

Is there a relationship between thinking skills and learning styles? Without doubt! Just as the key placed in the opening and the turning of the knob must be in harmony for the door to open, so it is with the learning and thinking skills of students and teachers in a positive learning environment. Each person needs to "shine" at least some of the time.

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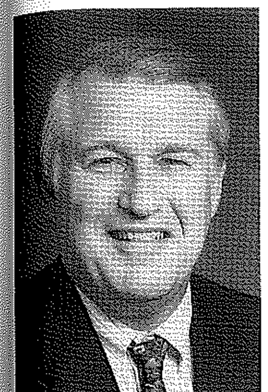
The Agriscience Connections Institute



BY: JOE W. KOTRLIK, PROFESSOR AND GERALDINE H. HOLMES

Dr. Kotrlik is a professor and Dr. Holmes is an assistant professor of vocational education at Louisiana State University, Baton Rouge.

For the past decade, agricultural education has responded to various legislative and political agendas. These agendas surfaced as a result of several reports on the status of education in the United States. Starting with A Nation at Risk: The Imperative for Educational Reform published by the National Commission on Excellence in Education (1983), several other significant reports followed in the mid and late 1980s, including Science for All Americans: A Project 2061 Report (American Association for the Advancement of Science, 1989), Biological and Health Sciences: A Project 2061 Report (American Association for the Advancement of Science, 1989), High School: A Report on Secondary Education in American (Boyer, 1983), and Understanding Agriculture: New Directions for Education (National Research Council, 1988).

These reports pointed out that science instruction in our schools needed strengthening and that our high school graduates were lagging in scientific literacy. Subsequently, science content is being strengthened in many of our high school agriscience programs.

More recently, the Carl D. Perkins Applied Technology Act (1990) promoted the integration of academic and vocational education and the new vocational education legislation, tentatively titled the Carl D. Perkins Career Preparation Education Reform Act of 1995 (also know as the U.S. Senate's Workforce Development Act by Nancy Kasselbaum), which also mandates that programs supported by the new law must give priority to integrating academic and vocational instruction.

Interest From Science Teachers

Science education is working hard to modernize their curricula. Although they probably wouldn't use this terminology, much of the current thrust is aimed at installing traditional agriscience education principles into science curricula. For example, a recent article by Joseph Krajcik titled "Learning Science by Doing Science" may sound very familiar to the "Learning by Doing" philosophy espoused by agriscience education throughout this century. In this article, Krajcik promotes what he calls project-based science, which has been known as the project method in agriscience education, and which indicates that it " . . . allows students to learn science by doing science and, as a consequence, actively construct their understanding of science by working with and using their ideas" (p. 54).

The connection to agriscience education is obvious. Science teachers are now very interested in teaching science in a format that emphasizes the applications of science in the real world. The funding of the project described later in this article is also proof of this assertion.

Why Work with Academic Teachers

There are several reasons why agriscience teachers should consider working with science, math, English, and other teachers to integrate academic and vocational education. First, this integration permits teachers to share scarce resources, which makes them "stretch a little farther" and ultimately improve the quality of education for all students. Second, this partnership with academic teachers can also serve as a powerful public relations and recruiting tool for agriscience programs.

Third, and probably most important, this integration can result in the strengthening of agriscience instruction because academic teachers could teach more of the foundations now being taught by agriscience teachers. If some of the content currently taught in agriscience classes could be taught in academic classes, this would allow agriscience teachers to teach at a more advanced content level.

Where Do We Start

With regard to integration of academic and vocational education, Bettina Lankard (1994) wrote that, "No matter how enthusiastic and committed teachers are to the concept of academic and vocational integration, their success demands that they acquire new skills and expand their knowledge to include information across the disciplines" (p. 1). Certainly, teachers cannot teach what they do not know. If we expect academic teachers to provide foundational instruction for agriscience students, then they must have some fundamental understanding of the academics needed in agriscience education.

One Solution

Two projects are currently under way in →

Louisiana: one, the Agriscience Connections Institute, is located at Louisiana State University (LSU), and another similar project is under way at Northeast Louisiana University (NLU). Although this article will address the project at LSU, the project at NLU is very similar.

The Agriscience Connections Institute (ACI)

The ACI at Louisiana State University involves academic and agricultural scientists, parish school system personnel, and industry personnel. The purpose of the project is to help high school teachers strengthen their instruction related to contemporary themes in life sciences instruction. There are three phases in the project serving 20 high school and middle school biology and environmental science teachers.

Phase I.

Phase I provided a three-week summer course which emphasized teaching methods, the use of educational technology, and the development of instructional materials by the teachers to be used in their classrooms. The materials developed by the teachers will be tested and redesigned during the following academic school year.

Ten university faculty members provided technical and applied information related to their particular fields during a workshop and course conducted in June, 1995. Topics in the summer course included: Introduction to Fast Plants; Bottle Biology Basics; Genetic Manipulation; Electrophoretics; Interdependency and Interactivity of Ecological, Technological and Sociocultural Systems; High-Tech Agriculture's Role in Future Food Production; Role of Food Animals in an Ever Changing World; Urban Forestry; Insect Diversity and Interaction with the Environment; Careers in Agriscience; and Instructional Planning. Faculty members provided useful activities that the teachers could use in their classrooms. Examples of how to substitute or scale down projects and experiments using inexpensive materials were also demonstrated or explained.

Field trips gave the participants opportunities for hands-on activities, allowed them to see firsthand technical agriculture resources that were available to them, as well as ongoing research and innovations in the area of agriscience. Three research centers were visited: (1) The LSU Rice Experiment Station which is the world leader in the conduct of research in rice genetic engineering and has a foundation seed program; (2) the LSU Embryo Engineering Laboratory which has pioneered and replicated many innovative procedures in embryo splitting and genetic manipulation technology; and (3) The LSU Aquaculture Laboratory where fisheries, animal science, and environmental researchers address problems and needs in aquacultural production and aquacultural production's coexistence with sugar cane, cattle, and other agricultural enterprises.

During Phase I, time was allocated for teachers to go on a resource foray. Teachers visited such places as local libraries, museums, resource and instructional centers, places of business, and educational departments where they obtained technical agriculture materials for use by themselves and other participants.

Phase II.

During Phase II, each teacher will attend three one-day sessions within the academic year to view additional technological implementations. Teachers will continue developing and testing their own instructional materials for course development. Project staff will provide ongoing consultation on the instructional materials development and testing. ACI staff will also provide information and technical assistance in the design of the teaching activities. Sharing of the materials among other science teachers in the participants' schools will be encouraged in an attempt to increase the impact of the project.

Each teacher will be visited at least twice during the academic year by ACI staff members who will provide opportunities for demonstrating teaching methods that incorporate ideas from the previous summer session, and who will give staff members an opportunity to see teachers in their element. Six technical agriculture professors are employed by the ACI and are available to the teachers as needed.

The teachers are keeping journals of various practices they try out with their students. The journals will provide in-depth information on adjustments made to classroom teaching and assessment techniques. Also, the journals will provide information for sharing experiences during the second summer workshop in June, 1996.

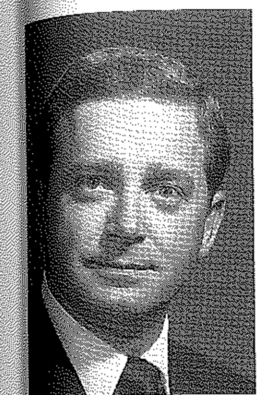
Phase III.

In the second summer of the project (June, 1996), a two-week institute will be organized. The first week will be used to exchange experiences, discuss solutions to problems encountered in incorporating the new materials into the classroom, complete instructional materials, and expand into other content areas identified by the participants and staff.

During the second week, one or two students selected by each participating teacher will attend. They will provide an audience for application of teaching techniques and materials

(Continued on page 19)

Agricultural Education In The United States: Types Of Teaching Positions By Region



By: William G. Camp

Dr. Camp is a professor of agricultural and extension education at Virginia Tech, Blacksburg.

Since 1965, researchers from the Agricultural Education Division of the American Vocational Association have conducted an annual National Survey of the Supply and Demand for Teachers of Agricultural Education in the United States. The annual studies were conducted from 1965 until 1973 by Dr. Ralph Woodin, initially of the Ohio State University and later from the University of Tennessee, Knoxville. The study was continued by Dr. David Craig of the University of Tennessee from 1974 until 1984. Since 1985, Dr. William G. Camp from Virginia Tech has conducted the study except for 2 years when Dr. J. Dale Oliver, also of Virginia Tech, was responsible for the research.

This is the fifth in a series of reports to the profession on the results of the annual supply and demand study. For more details about the background of this ongoing study, and on the sources of the data, see the first article in this series, in the May, 1995 issue of *The Agricultural Education Magazine*.

Types of Teaching Positions

There were 10,119 teachers of Agricultural Education in the United States in September, 1993. An examination of the table below, reveals that the vast majority of those teachers worked exclusively in high school programs (n = 7,878). Most of the remaining teachers (n = 1,125) taught in combination high school and junior high or middle school settings. When the small number of teachers reported as teaching in two separate schools (n = 200) is considered, it appears that most of the "combination" teachers must be on adjacent or single campuses. Most teachers were in single-teacher departments (n = 5,753). Based on the findings of this study, a typical Agricultural Education teacher in the United States works in a general or comprehensive high school, in a single-teacher department, and has no adult or Young Farmer responsibilities. ■

Numbers of Agricultural Education Teachers by Grade Level and Department Sizes on September 1, 1993 [a]

GRADE LEVEL:	Central	Eastern	Southern	Western	US Total
High school only	2,093	882	4,062	841	7,878
Junior high or middle school only	6	12	287	11	316
Combination high school and junior high or middle school	581	62	334	148	1,125
Adult and/or Young Farmer only	52	36	100	0	188
Grade level not reported					
ADULT EDUCATION:					
Teachers with at least some adult and/or Young Farmer responsibilities	513	139	1,669	74	2,395
MULTIPLE SCHOOLS:					
Teachers teaching in more than one school	77	19	67	37	200
DEPARTMENT SIZE:					
Single teacher dept.	1,943	321	2,804	685	5,753
Multi teacher dept.	773	563	1,869	315	3,521
Dept. size not reported					320

[a]Actual reported numbers included fractions since some teachers are employed part time. The data reported here are rounded off to whole numbers for ease in interpretation.

LOOK FOR THIS

In the next article in this series, we will begin to examine the numbers of new graduates of university agricultural education programs.

FEATURE ARTICLE

Agricultural Education Still Holding True to "Old Ways"

BY: MICHELLE SAMMON

Ms. Sammon is an undergraduate student in agricultural education at the University of Wisconsin - River Falls and the winner of the 1995 Alpha Tau Alpha essay contest.

Times are changing, people are changing, and agricultural education is changing. However, the problem-solving method used to teach agriculture is not changing as it should. Problem solving involves the evaluation of information by students to equip them in solving problems. Newcomb, et. al, demonstrates this when he states:

> Consider the fact that every day people learn on their own, without the presence of teachers. How is it that people go about learning on their own? What process do people follow daily as they encounter problems, questions, or obstacles that require them to think, ponder and study in order to solve the problems confronting them (65)?

Problem solving has long been advocated as a traditional method in agricultural education, whereas other disciplines are realizing how advantageous it can be to teach problem-solving techniques. In agricultural education it's essential to learn how to solve problems due to new trends and technological advances. A teacher could teach students how to run a computer program, but by the end of the school year, that same program may be obsolete. If the students had previously learned how to solve problems, the basic steps to run a software program wouldn't be as difficult. For a student who never learned problem-solving, running the same software could become much more complex. The student may even lag significantly behind others in technological advances.

In today's agricultural education departments, the problem-solving approach should continue to be advocated as an crucial method of teaching. Trends in agriculture change rapidly and cannot always be taught individually; thus this method has many advantages over other methods of teaching and the problem-solving approach should remain unaltered. Osborne and Phipps state:

> Those who pass by problem-solving in teaching assume that they are able to select the essentials in agriculture which students need to know and that students will retain what they are taught. But true agricultural education means a different thing. The changes in agriculture are rapid. The problems of the future will not be the same as the problems we face or the problems our ancestors faced in agriculture. If public school departments of agriculture cannot give their students the ability to solve the problems they meet, they are not providing agricultural education (152).

A problem-solving approach to learning facilitates in promoting democratic ideas and opinions. As teachers, we desire that our students learn by thinking. Problem solving is one of the major methods by which students can do this. According to Newcomb, et. al, the problem-solving approach to teaching involves six key elements, which are interest approach, group objectives, questions to be answered, problem solution, testing solutions through application, and evaluation of solutions (67).

By using these key elements, problem solving encourages creative thinking, motivation, and allows students to develop and expand their thinking abilities. According to Newcomb, et. al, several essential principles are utilized in the problem-solving approach. Problem solving allows students to think and formulate solutions when they encounter an obstacle or challenging situation. Using this approach allows for an active learner rather than a passive learner. Learning also becomes more directed. This approach enables students to put into practice what they've learned previously. This problem-solving approach also

tends to improve learning. As Newcomb, et. al, states, "...students should 'inquire into' rather than be 'instructed in' the subject matter" (71). Thus, learning can be maximized to its fullest potential (Newcomb, 71).

Other methods of teaching, such as questioning and memorization, are not as effective as problem solving. While questioning could lead to problem solving, it may only ask for an answer and fail to probe for solutions to problems. Memorization merely require regurgitating information, thus leaving students unequipped to deal with varying situations. Problem solving ensures the students will not have inadequate responses to problems because it enables students to adjust their solutions to the problems by using various steps. Some steps suggested by Straquadine are experiencing a provocative situation, defining the problem, seeking data and information, formulating possible solutions, testing proposed solutions, and evaluating the results (22).

Problem solving encourages a higher level of thinking because students actually have to apply what they've learned rather than just answer basic questions. This method allows thinking beyond the knowledge level of the cognitive domain.

Life involves many problems, from deciding what to wear, buying a car, or determining the answer to a complex problem. Furthermore, to become successful individuals and leaders, students need to solve problems while they progress through life. Therefore problem solving is an effective method, not only in agriculture, but in life and should continue to be taught.

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The Agriscience Connections Institute

(Continued from page 16)

developed as a part of this program and provide teachers an opportunity to model techniques of teaching. The students will also participate in sessions that broaden their knowledge of career possibilities in science, particularly as it applies to agriculture, and to enrich their science awareness.

As a part of Phase III, all instructional materials developed by the teachers will be collated into a teaching resource. Each participating teacher will receive a copy of the completed and tested instructional materials. Additional copies of the materials will be provided to the state resources information center and will be available for loan to other teachers in the state. Each set of instructional materials will incorporate appropriate student achievement assessment techniques. These assessment techniques will emphasize evaluation of learning for improvement and additional learning, rather than terminal determination of attainment. These formative assessment techniques will continue to be demonstrated to teachers in the Phase III summer course.

Where To From Here?

This project has the potential to elevate the level of science-based instruction in Louisiana's agriscience education programs. The next step will be to encourage agriscience teachers to seek opportunities to forge partnerships with science teachers in their schools. The nice thing about this effort is that everyone—agriscience and science teachers and their students—truly can be winners!

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Monitoring the Plant Environment: An Electronic Instrumentation Learning Activity

By: Donald M. Johnson

Dr. Johnson is an Associate Professor of Agricultural and Extension Education at the University of Arkansas, Fayetteville.

Introduction

Electronic instrumentation is the process of measuring phenomena electronically. Agricultural applications of electronic instrumentation are virtually limitless, ranging from planter monitors to global positioning systems and from digital weight scales to machine vision systems. Because of the widespread and growing use of electronic instrumentation in agriculture, students should be provided with learning experiences that teach basic principles and applications of these electronic devices.

Purpose

This article describes a classroom activity that allows students to learn basic principles of electronic instrumentation by building instrumentation modules that monitor the plant growth environment (Figure 1). Specifically, the instrumentation modules measure relative temperature, light intensity, and soil moisture and then represents these values as readings on a digital multimeter (DMM). Circuit schematics and operating principles for each instrumentation module are described. Finally, circuit assembly methods are briefly discussed.

Instrumentation Modules

Temperature, light, and moisture are three primary environmental factors affecting plant growth. In artificial environments (such as greenhouses), these factors are carefully monitored using sophisticated electronic instrumentation devices. The three modules described in this section, while less sophisticated than commercial devices, should help students to understand the basic principles of electronic instrumentation.

Temperature

The temperature instrumentation module is a voltage divider circuit built around a thermistor and a 10,000 ohm (10K) potentiometer. A thermistor is an electronic device having an electrical resistance that varies inversely with temperature (resistance increases with a decrease in temperature; resistance decreases with an increase in temperature). A potentiometer is a variable resistor that can be adjusted manually to a specified resistance value within its operating range. A schematic drawing of the temperature instrumentation circuit is shown in Figure 2.

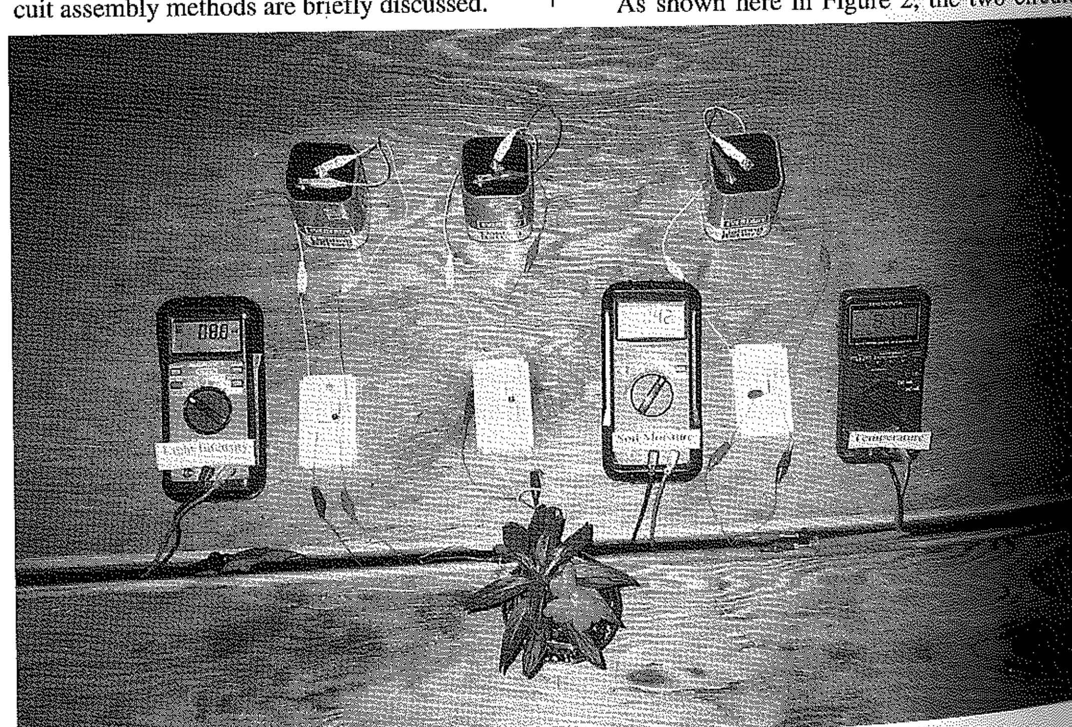
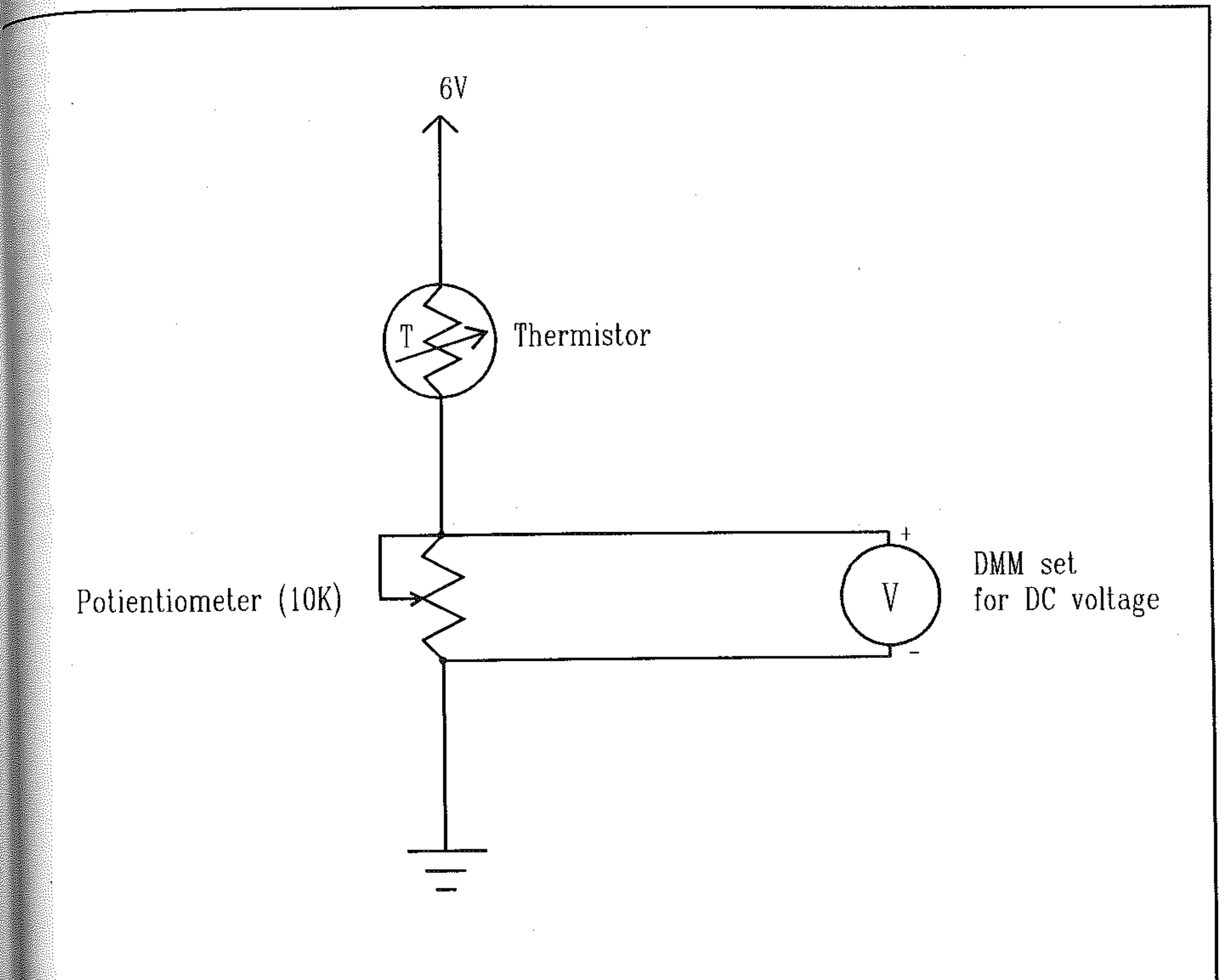


Figure 1. Instrumentation for Monitoring the Plant Environment.



ure 2. Temperature Instrumentation Circuit.

As shown here in Figure 2, the two circuit loads (thermistor and potentiometer) are connected in a series. The circuit (source) voltage is supplied by a 6 volt battery. The DMM is set to read Direct Current (DC) voltage, and the meter leads are connected across the terminals of the potentiometer.

According to Kirchoff's Voltage Law, the sum of the voltage drops in a series circuit will be equal to the source voltage. Furthermore, the voltage drop across each load in a series circuit will be directly proportional to the load's resistance.

Kirchoff's Voltage Law explains how the temperature instrumentation circuit works. As temperature increases, the resistance of the thermistor decreases. This, the voltage dropped across the thermistor also decreases (since the voltage drop across a load is proportional to the load's resistance). Since the sum of the voltage drops in the circuit must be equal to the source voltage, the voltage drop across the potentiometer must increase as the voltage drop across the thermistor decreases. Since the DMM is set to measure the voltage across the potentiometer, an increase in temperature is digitally displayed as an increased voltage reading on the meter.

Lighting Intensity

The light intensity instrumentation module is also a voltage divider circuit. The circuit is built around a cadmium sulfide photocell and a 10K potentiometer. A photocell is an electronic device having a resistance that varies in inverse proportion to light intensity (resistance increases as light intensity decreases; resistance decreases as light intensity increases). Figure 3 is a schematic drawing of the light intensity instrumentation circuit.

As shown in Figure 3, the light intensity module uses the same basic circuit as does the temperature module, except that the thermistor is replaced by a photocell. As before, the source voltage is supplied by a 6 volt battery and the DMM is connected to measure the voltage across the potentiometer.

As light intensity increases, the resistance of the photocell decreases. this decreased resistance reduces the voltage dropped across the photocell. Thus, according to Kirchoff's Voltage Law, the voltage drop across the potentiometer must increase. Since the DMM is set to measure the voltage across the potentiometer, an increase in light intensity is displayed as an increased voltage reading on the meter.

Soil Moisture

The circuit schematic for the soil moisture instrumentation module is shown in Figure 4. The circuit contains a fixed resistor (sized to limit maximum current flow to slightly less than the meter's capacity), a 10K potentiometer,and a DMM (set to measure DC amperage). The positive terminal of the 6 volt battery is connected through the fixed resistor and the potentiometer to the positive lead of the DMM. The negative lead of the DMM serves as one soil probe, and the second soil probe consists of a separate lead connected to the negative terminal of the battery. Placement of the two probes in the soil completed the electrical circuit.

The operation of the soil moisture circuit is based on Ohm's Law. According to Ohm's Law, the amount of current flow (amperage) through a circuit is determines by the total resistance of the circuit (Amperage = Voltage / Resistance). In this circuit, the total resistance is the sum of the resistances of the fixed resistor, the potentiometer, and of the soil between the two probes.

As the water content of a soil increases, the soil's electrical resistance decreases. If the potentiometer's resistance remains constant, the total circuit resistance will decrease as soil

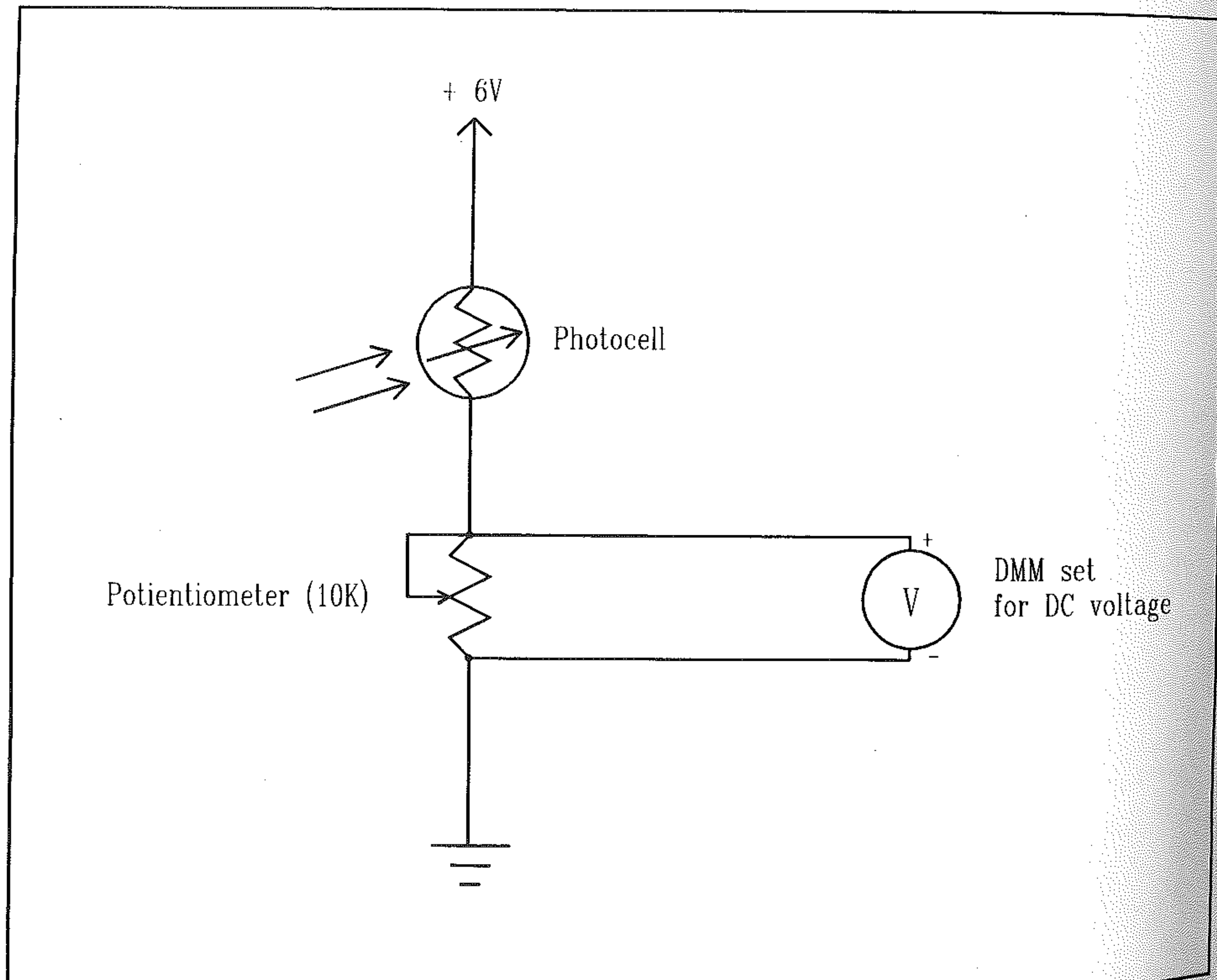


Figure 3. Light Intensity Instrumentation Circuit.

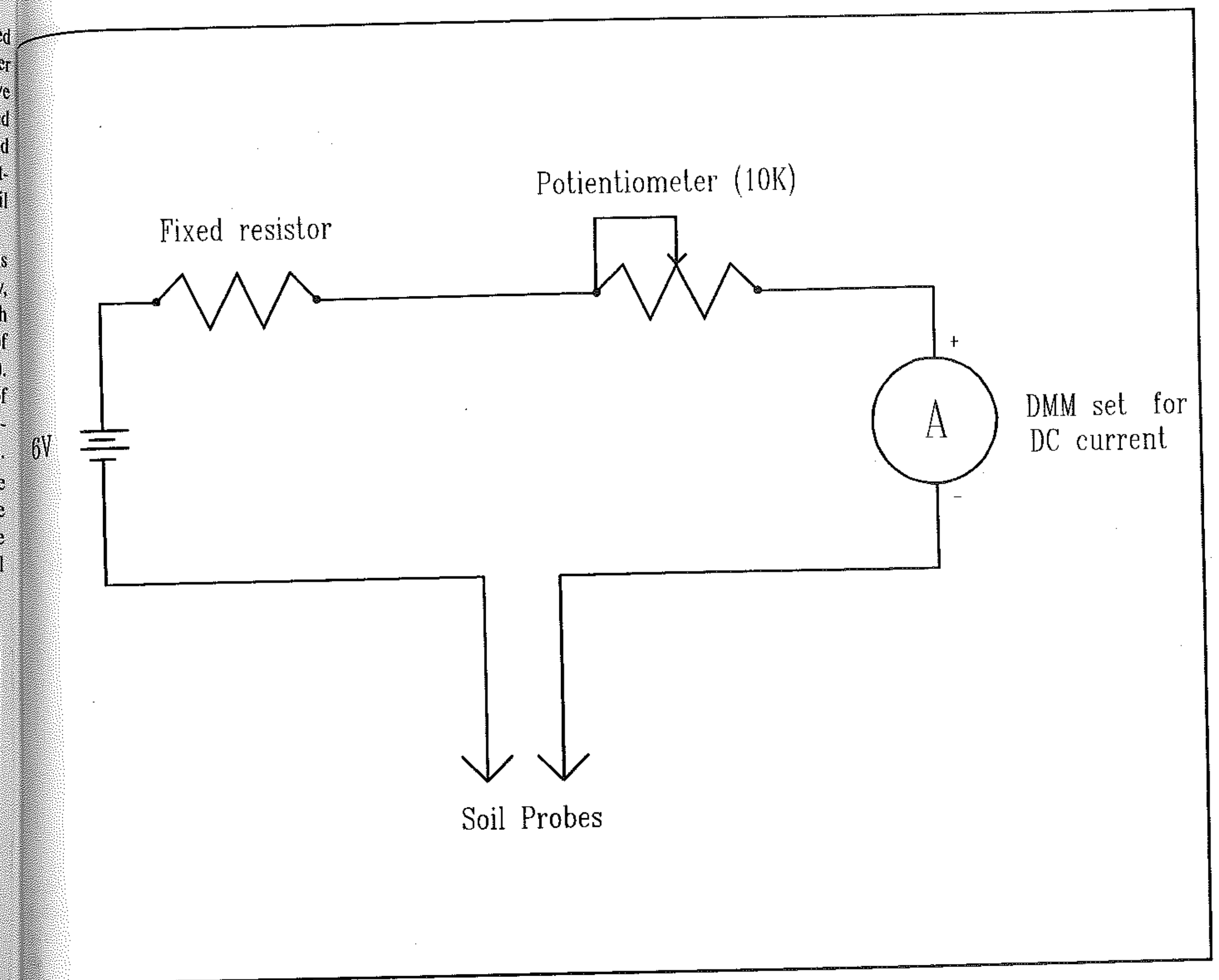


Figure 4. Soil Moisture Instrumentation Circuit.

moisture increases. Since current flow in inversely related to resistance the current flow through the circuit will increase as soil moisture increases. Thus, and increase in soil moisture is displayed as an increased amperage reading on the DMM.

Circuit Assembly

The circuits described in this article are easy to assemble using any one of three methods. The fist method is to simply make the circuit connections using insulated leads fitted with alligator clip connectors. This method has the advantage of allowing students to see the actual wiring connections. The second method is to use inexpensive breadboards with plug-in sockets to assemble the circuits. While the actual wiring connections will be less visible, this assemble method is neater than the first method. Finally, if permanent versions of the circuits are desired, students can make the necessary connections and solder the components to a circuit board.

Summary

Electronic instrumentation devices are widely used in the agricultural industry. Agricultural educators should provide their students with active, hands-on learning experiences that teach the basic principles and applications of this technology. If students have an understanding of these basics, they will be in the position to adapt to new developments in this rapidly emerging field. Hopefully, the learning activity described in this article will assist teachers with this important task.

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NEWS RELEASE

Agricultural Entrepreneurship Recognized, Celebrated

Kansas City, Missouri—Ten of the nation's top student agricultural entrepreneurs received $1,000 awards in recognition of their entrepreneurial accomplishments. The students were recognized during the National Agri-Entrepreneurship Education Development Forum held recently in Kansas City, Missouri, in conjunction with the 68th National FFA Convention.

During the forum, participants heard from several agriculture and entrepreneurial leaders. Mike Jackson, president and owner of Agri Business Group, Inc., of Indianapolis, moderated the event and provided entrepreneurial insight. Jackson focused his opening remarks on the changing picture of American business.

"We often tend to think about the creation of jobs as something that only large corporations can do. When, in fact, 75 percent of the American labor force works in companies with fewer than 100 employees. Fully 60 percent of Americans work for companies with fewer than 20 employees, Jackson explained. "In 1995, Americans started three million companies, the vast majority of which had fewer than 20 employees. Entrepreneurship is the engine that drives our economy."

Bob Rogers, chairman and chief executive officer of the Ewing Marion Kauffman Foundation in Kansas City, the program's primary sponsor, echoed Jackson's remarks. "Entrepreneurship is the key to wealth and job creation in our country," Rogers told forum participants. "It is critically important to develop entrepreneurial skills and mindsets early in life. I salute your efforts and entrepreneurial endeavors."

Forum attendees also heard from Richard Lugar, U.S. Senator from Indiana and presidential candidate; Harry Cleberg, president and chief executive officer of Farmland Industries, Inc., Kansas City, Missouri; Mark Williams, president and owner of Mark's Landscaping, Inc., Oviedo, Florida; Larry Case, coordinator of agriculture and rural education, U.S. Department of Education, Washington, D.C.; and W. Bruce Crain, director of the Alternative Agricultural Research and Commercialization Center, U.S. Department of Agriculture, Washington, D.C.

The National Agri-Entrepreneur Award Program recognizes students who start their own businesses and encourages students to consider careers as employers instead of employees. To qualify for national recognition, each student's application had to be accompanied by a chapter application containing his or her instructor's entrepreneurship teaching strategies. Each of the top ten chapters also received a National Agri-Entrepreneur Award and $1,000. The winning students and chapters are as follows:

Student / **School**	**Advisor**
Paul Baker	Joe Cosentino
Sanger High School, Sanger, CA	
Michael Case	Brenda Smith
Norborne R-VIII High School, Norborne, MO	
Johnathan Clough	Richard Schmidig
Linden High School, Linden, CA	
Chuck Hayslip	J. Corbett Phipps
Ohio Valley Vocational School, West Union, OK	
Michael Jackson	Keith Kolpack
Barron High School, Barron, WI	
Michael McIntyre	Bud Postma
Madison High School, Madison, SD	
Charles Pearce	Lisa Mullen
Big Foot Union High School, Walworth, WI	
Nathan Shaffer	Channing Stowell
Smith Center High School, Smith Center, KS	
Chris Stephens	Mike Stephens
Chickasha High School, Chickasha, OK	
Jere Stewart	Shawn Dygert
Kuna High School, Kuna, ID	

The forum was part of the Agri-Entrepreneurship Education Program which is sponsored by the Center for Entrepreneurial Leadership Inc. of the Ewing Marion Kauffman Foundation in Kansas City, Missouri. Agri-entrepreneurship is a new initiative for agricultural education and is one of the profession's top priorities. The National Agri-Entrepreneurship Education Development Forum was conducted as a joint activity of the Center for Entrepreneurial Leadership, the National Council for Agricultural Education, the National Vocational Agriculture Teachers' Association, the National FFA Organization, the National FFA Alumni Association, the National FFA Foundation and the U.S. Department of Education.

The Ewing Marion Kauffman Foundation's vision is self-sufficient people in healthy communities. To accomplish this vision, the Foundation operates programs and provides grants in entrepreneurship education, entrepreneurship training and youth development. The Foundation develops collaborative relationships with other organizations to work toward common goals. Due to agricultural education's long-standing focus on youth development, self-sufficiency and its Kansas City heritage, the partnership is a natural.

Established in 1984 and representing the entire agricultural education community, the National Council for Agricultural Education fosters creative and innovative leadership for the improvement and further development of agricultural education.