

**Problem Solving - The Art and Science of Teaching**

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Teaching is a concept that sparks many diverse views when educators begin to discuss the process or describe what constitutes good teaching performance. As a profession, teaching has received widespread attention since the human race began to record its thoughts on what is a master teacher and what that master teacher should accomplish. One only needs to visit a university library and scan the books on the shelves dealing with teaching to begin to comprehend the magnitude of previous thought on this topic and to realize that in these books lie a diverse viewpoint on the strategies of teaching. Any argument for problem solving as an approach to teaching must first consider the total teaching/learning process and then examine how problem solving interfaces with what is known about learning theory and our beliefs on education. This article takes that broad perspective on education and later focuses on the strengths of problem solving as an approach to teaching.

The act of educating is the most serious responsibility that a society must accept, if indeed that society desires to exist in the future. A society must not only decide what values or beliefs are worthy of passing onto the future generation, but it also must decide what skills are needed by the future generation to carry on those values or beliefs. Teachers must ask themselves, and be ready to answer, a series of questions when preparing for the responsibility of educating the future generation. Examples of these questions follow.

How should I teach?

What do I believe when it comes to how people learn?

Does every student have the ability to think and to learn?

What value should I place on humanistic approaches to teaching?

What does society expect its members of tomorrow to learn today?

Where do I stand on the behaviorist versus the phenomenological orientation to educating people?

How or should I use the thinkings of Aristotle, Dewey, Thorndike, Skinner, Locke, Rogers, Gagne, Lancelot, and others?

What did these early thinkers believe about the educational process and what implications do their thinking now have on a space-aged and computerized society?

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## What do I, as a teacher believe?

Teaching never stands alone. The process of teaching can never and should never be discussed, debated, or considered without attention being given to the rudimentary elements of education: namely teaching, learning, student, teacher, environment, society, ideals, and life. Education involves every one of these elements and every one of these elements involves education. One who teaches without giving thought to each of these rudimentary elements is not a teacher at all, but an imposter, an individual who society cannot or should not tolerate. The master teacher is an individual who can synthesize the interrelationships of these rudimentary elements and internalize these interrelationships within his/her own philosophy. This synthesis should result in achieving the ultimate goal of providing to students a teaching/learning environment where the climate for learning is maximized and the learning inhibitors are minimized. The most cardinal value that problem solving as an approach to teaching can contribute to the goals of education is that it provides a means whereby societal values and ideals can be passed to the future generation through a procedure where the teacher can fully incorporate the uniqueness of each rudimentary element of education into the teaching/learning process.

The development of a fundamental understanding of the problem solving process by an individual soon becomes very complex when one begins to consider all the obvious and less obvious intricacies of the teaching/learning environment and how problem solving relates to these intricacies. Before discussing problem solving further, we must first consider the teacher's philosophy on education and life. The covert feelings and thoughts of a teacher will purposely guide and unknowingly influence a teacher's overt actions to which students will be subjected. The teacher must hold as the base of all teaching, knowledge. According to Hitopadesa (Ulich, 1961) among all things knowledge, they say, is truly the best thing; from at all times, its unstealableness, its unpurchaseableness, and its indestructibility (p. 10). At first glance, one would believe that Hitopadesa, in about 500 AD, was referring only to knowledge in a scientific sense, in terms of facts or figures. But when reflecting upon his writings, he would also include the knowledge needed by people to think, solve problems, and eventually assume their place in society by successfully working with their fellow citizens. Plato said (Ulich, 1961) the direction of the education from whence one starts is likely to determine the quality of what follows (p. 43). A review of these beliefs and the writings of other early scholars indicated that great value was placed on knowledge and the ability to think, and that education influenced the degree of success experienced by an individual in the future.

A teacher must remember that teaching agricultural knowledge for the sake of knowledge falls short of what education is to accomplish. Students must also be challenged to develop their thinking ability by taking the knowledge learned, reorganizing it in tomorrow's

environment, making sense, order and application of it. The value of teaching our students how to think will be even more critical in the informational world of the future. Kammi (1984) in her recent article in *Kappan* pointed out that an individual who is intellectually heteronomous will unquestioningly accept what he or she is told, including propaganda (p. 413). We need to develop in agricultural students an intellectual autonomy, which implies the ability to conceptualize problems facing the agricultural industry of today and tomorrow, combined with a supportive and responsible attitude for identifying solutions to those problems.

To summarize a philosophy for a teacher of agriculture into a working definition, I propose that it is the responsibility of an agricultural teacher to guide the learning process of students with a humanistic touch, to assure the acquisition of appropriate agricultural knowledge which might not otherwise be learned by students, and to develop in students the reasoning and problem solving ability to transfer knowledge to real life situations beyond the school. The aim of this philosophy is to prepare students to help solve problems restricting the advance of agricultural knowledge and to accept their responsibility in helping to solve problems facing society in general. Agricultural educators must accept this philosophy if they are to assume responsibility in helping society pass to future generations those skills, values, and ideals crucial to the preservation and advancement of agricultural knowledge needed by society. The major challenge for teacher educators is how can we best prepare our teachers to meet this expectation.

If we believe:

- a) that students do not learn by thinking,
- b) that consideration of the student as a human being should not influence the learning approach used,
- c) that knowledge learned today will suffice for the knowledge needed tomorrow,
- d) that students should assume a passive role in the learning environment,
- e) that all knowledge to be learned by the student must originate from the teacher,
- f) that students cannot learn from their own experience or that of others,
- g) that knowledge learned is automatically transferred to other situations, or
- h) that a teacher's personality cannot have a positive influence on the teaching/learning environments,

then problem solving is not for us. We should distribute tables of random numbers to our teachers for use in selecting teaching techniques and instructional aids, irrespective of the instructional topic, the learning situation, or the students involved.

He leads and does not drag; he strengthens and does not discourage; he opens the way but does not conduct to the end without the learner's own efforts (Confucius as interpreted by Ulich, 1961, p. 21).

We learn an art or craft by doing the things that we shall have to do when we have learnt it (Aristotle as interpreted by Ulich, 1961, p. 78).

What is required is that every individual shall have opportunities to employ his own powers in activities that have meanings (Dewey, 1916, p. 203).

The answer to many of life questions are found in experience. The human mind has the ability to profit from the experience of others (Stewart, 1950, p. 1).

Education is the process of drawing children towards that principle which is pronounced right by law and confirmed as truly right by experience of the oldest and most just (Plato as interpreted by Bury, 1926, p. 659).

Our greatest ultimate goal in problem teaching is to make our students able to solve new problems without help . . . In the degree in which we make our young people able to do this, we shall have truly educated them (Lancelot, 1929, p. 134).

Educational procedures are generated from general views about human nature and about the kinds of goals and environments that enhance human beings (Joyce and Weil, 1972, p. 5).

As computers begin to take over some basics of education, schools will more and more be called upon to take responsibility for teaching values and motivation, if not religion (Naisbitt, 1984, p. 45).

To the situation, a modifiable connection being made by him between a situation S and a response R, man responds originally, other things being equal, by an increase in the strength of that connection (Thorndike, 1925, p. 70).

The organism is dominated and its behavior organized only by unsatisfied needs (Maslow, 1970, p. 38).

Theory and practice should be bound together in learning if they are to contribute to each other--if they are to recur together (Hammonds, 1950, pp. 22-23).

What has been clearly demonstrated in the past ten years is that effective learning programs for these children can be designed by building upon the particular personal assets of the children involved and providing the essential conditions for constructive learning (Tyler, 1976, p. 25).

Nations, more than knowledge, impart attitudes (Conant, 1963, p. 113).

The environment will do the teaching (Skinner, 1968, p. 153).

Learning is a change in human disposition or capability, which can be retained, and which is not simply ascribable to the process of growth (Gagne, 1965, p. 5).

The intrinsic quality of the problem solving approach to teaching is that it provides the teacher the opportunity and gives the teacher the responsibility to capture the full significance of each philosophical statement and scientific finding related to human learning just mentioned as well as others not mentioned. Problem solving is the culminating step in a sequence of learning theories that can be traced to the early beliefs in learning styles and to the pioneer findings of the initial stimulus--response scientific experiments. The art of teaching and the science of teaching can truly be incorporated in the learning environment through the problem solving approach. The teacher can develop pre-teaching/learning strategies based on scientific theories and what is believed about the teaching/learning process, while the art of appropriate adjustments in teaching/learning activities can be made during the actual teaching.

The use of problem solving allows the teacher to:

- a) start the learning process at the level where the students are found,
- b) establish a learning environment where students can learn from experiences of others and that permits a comparison of viewpoints,
- c) encourage students to question others,
- d) involve students in their own education,
- e) provide positive reinforcement,
- f) provide immediate reinforcement and feedback,
- g) question students with varying degrees of difficulty to clarify points, assess understanding, reaffirm knowledge, stimulate student thinking,
- h) observe change or the lack of change in behavior of students rather than waiting for traditional quizzes or tests,

- i) adjust the teaching to the learning pace of the class,
- j) transfer what is learned beyond the school,
- k) demonstrate the students how to solve problems, and
- l) develop intellectual autonomy in students, and incorporate the rudimentary elements of education into the act of teaching.

The Moores point out that one of the early assumptions associated with using problem solving was that most students had supervised occupational experience programs (SOEP), and now with many students not having SOEPs, problem solving is not appropriate. Analyzing this situation, we find that the real problem is with students not having SOEPs, not with the problem solving approach to teaching.

The effective use of problem solving rests with only one person, the teacher. Where strong agricultural education programs exist, good teaching is responsible: where weak programs exist, poor teaching is responsible, (Crunkilton and Krebs, 1982, p. 251). If the teacher does not understand the procedures to follow in conducting a class through problem solving, the students will neither grasp the information intended nor be able to transfer the problem solving reasoning skills to other situations. Stewart (1950) states that the chief reason pupils do not learn to think as we wish them to is that our teaching situations often do not require thought (p. 9). Teaching must go beyond the infant stage of identifying this or that and answer the questions, so what? or why? Only by taking these additional learning steps through problem solving will we truly lead our students to the higher order of thinking.

The implication that secondary agricultural teachers should develop problem solving skills in their students also applies to teacher educators. We must develop problem solving skills in our undergraduates if they are to develop similar skills in their students. Dewey (1916) once noted nothing has brought pedagogical theory into greater disrespect than the belief that it is identified with handing out to teachers recipes and models to be followed in teaching (p. 199). Future teachers must know how to use problem solving skills in synthesizing the interrelationships of the rudimentary elements of education and be able to internalize these interrelationships into a personal model or philosophy congruent for a master teacher. This should be a goal of teacher educators and it will not be accomplished through a handing out process.

The problem solving approach to teaching has more importance and relevance today than it did 10, 20, or 50 years ago. One of Co-nants' (1963) four intellectual teaching skills needed by teachers centered around the democratic social component. Our society is based on democratic ideals and modes of operation and now it is highly influenced by informational systems. The problem solving process, if used correctly by teachers, will illustrate to students how the basic democratic foundation of our new world operates and how students as

citizens can benefit and/or take their active right in governing themselves in an information based society. There are some in society who a few short years ago began to rely upon the pocket calculator to solve problems and who might not believe microcomputers can print out answers to problems. The fallacy and folly of this reasoning is that we must neither believe nor permit the future teachers to think that computers will make ultimate decisions. They only provide data. Final decisions on any problem must be made by human beings, individuals who have the best technical knowledge and who have the ability and desire to think and to arrive at sound decisions affecting the future, including the future of agriculture. There is no single teaching technique or approach that will with a 100% effectiveness transfer the ability to think and solve problems from one person to another, teacher to student. But, the best foundation discovered to date that captures all of the rudimentary elements of education into one process for developing this reasoning and problem solving ability in students is through the problem solving approach to teaching.

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