THE VISITOR

Devoted to the Interests of Agricultural Education in Minnesota Schools

Volume XLV April 1958 No. 2

Science, Math, Vo-Ag—Harmony or Discord

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Editor's Note: The article which appears below is taken from the February 1958 issue of THE AGRICULTURAL EDUCATION MAGAZINE where it appeared under the title of "Science and Mathematics vs. Vocational Agriculture?" The editor of THE AGRICULTURAL EDUCATION MAGAZINE and Mr. Hartzog have kindly given their consent to the appearance of this article in THE VISITOR. It appears here because we feel it is a timely, well-written article deserving of careful attention by all those interested in a brighter future for agricultural education. THE VISITOR will be pleased to receive comments either pro or con regarding reader reactions to Mr. Hartzog's observations.

For some months now in the professional—and more recently in the popular—press there has been considerable agitation for a sharp increase in the amount of mathematics and science training offered in schools. Since the rise of the Russian moons, Sputnik I and Sputnik II, this rumble has become a crescendo. Prominent politicians and obscure professors have almost been tumbling over one another to get into the act and point the finger of doom at our educational system. College professors — even professors of agriculture — have been pointing at vocational agriculture as an influence which prevents "adequate" preparation of students for success in college. With a conviction and enthusiasm worthy of better things, these research oriented people have jumped to this conclusion without evaluating the amassed evidence of research on the problem. This is concisely expressed in an article by Mr. Walton in the March 1957 issue of *Agricultural Education Magazine* entitled "Does Vo-Ag Prepare for College?" He says:

> "The great body of evidence in the United States concerning the quality of college performance on the part of vocational credit students as compared to non-vocational credit students is repetitious with such phrases as 'no significant differences,' 'superior in agriculture,' 'equal in other fields,' 'vocational agriculture is as satisfactory as other curricula for college preparation,' 'no significant differences,' 'former students of vocational agriculture excelled by one third of a mark.'"

One wonders at the naivete of the educational spokesmen who ignore this evidence.

Are We Playing Checkers With Course Titles?

Reports indicate that Russian students have as much as seven years of mathematics, five years of physics, and three years of chemistry at the end of what compares to our secondary schooling; and that as little as 17 percent of our secondary school time is devoted to serious study of mathematics and science. Secondary school people are being urged from all quarters to increase requirements in mathematics and science, and in the crowded school day something will have to give. We often have a tendency to revise courses of study and curricula by playing checkers with course titles without looking beneath the title to determine the nature of the understandings, skills, abilities and attitudes which are intended to be the outcomes of the course.

We need only a casual knowledge of educational psychology to realize that out-of-context scientific generalizations, which are memorized by the student, are relatively valueless. They do not make sense, and therefore are defined by some critical thinkers as nonsense. In too many cases our students memorize the facts, laws and principles involved in a subject without making the meaningful associations that lead to understanding. The verbal memorization of an isolated law of nature, though it

VISITOR

Published quarterly during the calendar year in October, January, April, and July, by the Division of Agricultural Education, University of Minnesota, University Farm, St. Paul 1, Minn.

Entered as second-class matter at the post office at St. Paul, Minn., under the Act of August 2, 1912.

Accepted for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized August 2, 1918.

may be the essence of truth itself, unless understood in terms of meaningful relationships has about as much value as a concrete fly-swatter. To increase this kind of education might only compound the confusion. Fortunately, professorial thinking on this general problem has not all been shallow. In speaking of engineering education, Professor John Wilbur of MIT has this to say:

> "There would seem to be an advantage in teaching science and engineering in parallel with each other rather than following the time-honored custom of completing the first before the second is begun. If they were assimilated simultaneously, exact thinking and judgment could develop at the same time, and there could be full inter-play between the two—I am more interested in the co-requisites of mental developments than in the pre-requisites of subject matter. Too much preparation can stifle even the genius—or perhaps—especially the genius."

Science & Mathematics *and* Vocational Agriculture

Where then does vocational agriculture stand in this controversy? The title of this article implies that vocational agriculture stands at one side and is opposed to science and mathematics. If we look beneath the course titles perhaps we shall find that they are, in a sense, the same thing. Vocational agriculture and farm mechanics deal with and utilize the principles of science, biology, chemistry, physics and mathematics in their applications. Furthermore, vocational agriculture has the important advantage that its starting point is with phenomena that are familiar and important to the learner. The student of vocational agriculture has the opportunity to learn scientific and mathematic principles in the context of familiar and, to him, important problems. This makes use of the vital psychological principle of association.

What do we, as individual teachers, need to do to strengthen our program in relation to these implications? First, let us pay particular attention to the application of scientific principles that are demonstrated in our classrooms and in our farm shops. Let us evaluate each teaching unit in vocational agriculture for the opportunity to demonstrate in meaningful terms the underlying scientific law, principle or mathematic procedure which is involved. For example, the text book definition of osmosis, "the exchange of a thin liquid for a thicker liquid through a thin membrane," is a relatively sterile piece of information. How much more meaningful is the wilted plant brought about by a too strong soil solution, especially when amplified by examples of "fertilizer burn"; and how much more meaningful the recovery of wilted plants when the strength of soil solution is lowered by the addition of rainfall or irrigation water. Nor is the farm mechanics shop devoid of practical and excellent opportunities to teach science. Let us consider for a moment the very simple principle of artificial atmosphere. We find it in the de-oxidized atmosphere that exists in a forge fire and prevents the formation of scale; in the shielding gasses produced by the volatilization of the flux in shielded arc welding. We provide for it specifically in the inert gas arc welding process and again provide for it, incidentally, in the oxy-acetylene welding process where the carbon dioxide and water vapor—products of combustion—form a protective shield around the molten pool of metal. Yet another example—in the teaching of ignition trouble-shooting on tractor engines, the basic laws of magnetism and inducted currents are involved. We should point out the application of Ohm's Law in determining coil voltage and point it out again in the operation of the alternating current transformer which brings electric current to our farm. Taken out-of-context, being able to recite Ohm's Law is small comfort to the farmer with the stalled tractor, or for that matter, to the scientist with a stalled car.

If we teach vocational agriculture in this manner, and if we look beneath the course titles, we find that the high school student with four years of vocational agriculture, a

year of biology, a year of chemistry and a year of physics has seven years of science—not to mention the mathematics and the economics that are learned in a meaningful way rather than a forest of disconnected generalizations through which the student must grope.

Russian Dust Bowl in the Making?

A recent issue of *Newsweek* quotes Nobel prize winner, Hermann J. Muller, one-time senior geneticist at the Institute for Genetics at Moscow:

> "The shame of Russian sciences—biology. Russia can't be doing the basic refined work the West is doing as long as Lysenko's weird theories have currency."

This is further borne out by any student who cares to inform himself that in the past four years Russia has plowed up over 60 million acres of mostly marginal agricultural land in a vain attempt to provide ample food supplies for her tremendous number of people. On this land some 12 million young people—mostly from the cities and without benefit of agricultural education—have been expected to produce successful crops. Even the Russian press admits the results have been disappointing. Informed agriculturalists and geographers have predicted that this may be the world's greatest dust bowl in the making. This is an example that refutes the Lysenko philosophy that Nature can be compelled. If the Russian system of education is so admirable, to what do we attribute this colossal blunder? The rigorous, lengthy education of Russian youth in science and mathematics has not prevented what could amount to a national catastrophe. Let us consider for a moment the possibility that concentration on pure science and mathematics learned out-of-context of its environment and applications might be a contributing factor. Should we stand by and let unthinking people detract from the quality and quantity of our excellent agricultural education which has produced an agricultural technology that is the marvel of the world? To do so compares to throwing out the baby with the bath water.

Should All Students Follow Same Program?

The move to increase, by perhaps as much as several fold, the requirements in mathematics and science in our public schools seems to be based on the assumption that what is good for the relatively few extremely high caliber and well-trained scientists needed is also good for all of the students of all of the people. This assumption is open to challenge and could be another road to "educational wastelands." This move seems ill-advised when one looks at the total figures and realizes that it is unrealistic to expect more than 40 percent of our students to ever go on to college.

Let Us Remember to Teach the "Why"

The job for vocational agriculture workers is to keep our heads in this controversy, to defend our position and to strengthen our position by pointing out the amount of science and mathematics that we do teach. Perhaps we should evaluate our courses and emphasize the underlying scientific and mathematic principles with which we deal. We should be alert to opportunities to make applications of the laws of Nature. We might cooperate with the teachers of mathematics and science in our schools. We might deliberately select our lessons and demonstrations for the importance and breadth of applications of the principles involved. By so doing, we can lend more meaning to the mathematics and science courses taught by our colleagues in those teaching fields and thus strengthen the whole educational picture by surrounding the student with an environment of learning that has real meaning for him. In so doing, we can continue to do the excellent job of preparing America's farmers. Let us remember to not be satisfied with teaching "what" and "how"—let us also teach the "why."

Send Your Comments

To

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Thank You

Our Public Schools

LOYAL JOOS

American education is absolutely unique in this world; and this is not strange, because it is the result of an absolutely unique philosophy held in an unique country by an unique people. If you want to know what kind of society will be built in any country, look into the schools of that country. There you will find the future greatness of the nation, if it is to be great.

There are those who think that America is a rich and powerful nation because of natural resources, forgetting that other areas of the world have as great or greater resources. The secret of the success of the American people is to be found elsewhere than in the natural resources of America; it is to be found in the moral strength and know-how which our institutions of school and church have produced under an enlightened democracy.

Out of the schools of America have come great men: teachers, thinkers, dreamers, and doers. Each of them became something which it was his heritage to become, because he was an American, born and raised in freedom of thought, action, and opportunity. America has a right to be proud of the education system which has produced these great men, but it has also to be proud of the whole 170 millions of us who have learned how to produce and enjoy a gross national product of more than 430 billions of dollars worth of goods.

But there are those who are not proud of American education; there are those who would turn us back to a system of education which America abandoned more than fifty years ago, a system which is retained in European countries which have been responsible for two World Wars in those same years. These people say that if America is to survive, it must copy this obsolete system. They say that the individual needs of the student are less important than the needs of the state.

What is the truth? Has American education gone to seed? Are our schools abandoning their traditional tasks in favor of a hodge-podge of tap-dancing, typewriting, and tom-foolery? The truth of the matter is to be found not in a cursory examination of curricula, but in much more basic considerations. Why do our schools teach tap-dancing? Or typewriting? Or home economics? It is because our schools are trying to meet, and are succeeding in meeting, a problem which hasty critics of American Schools have not even considered; the problem of how best to meet the needs of the individual in modern life. These "snap" courses are not put in the school by half-baked dreamers but by practical men who are attempting to meet these needs.

It may be true that America needs more scientists; if it is, American schools will produce them, just as they have produced the best citizens, the best workers, the best farmers, and the highest standard of living in the world. But, you may say, how can typewriting produce scientists? Let us not forget that America will still need typists, tap-dancers, cooks, bakers, farmers, and college professors, as well as scientists. And all of these people will be, on the average, the best and happiest people in the world, because they will be in these occupations of their own free will and not because there was no other opportunity. Let us not forget either, that scientists cannot be made, unless they are first born equipped with the exceptional mental capacity required. Not more than five to ten percent of any nation's population could qualify for education of a scientific nature, and of these, America can and will find those who *want* to be scientists. America cannot and will not attempt to put the other ninety percent through a curriculum based upon the needs of the few who are exceptional.

Let us take a guided tour through our modern American public schools; let us examine their practices carefully; let us see what is really going on. This cannot be done in a day. There are many schools, and many kinds of educating going on in them. Some schools are country high schools; some are in large cities. Some are vocational schools; a few are technical. They all have one thing in common, which we must not forget: they are the life-blood of American democracy and American strength. They are the envy of the world. Scholars come from all nations to study them, and take home ideas. We have much to learn from this study of our schools. When we are through, we may have a better idea of how they may be improved.