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ABSTRACT

A study examined technology refusal within the context of applied academics and, specifically, the applied biology and chemistry curriculum used in Pennsylvania. It identified school cultural factors that acted as barriers to technology implementation and developed a framework for inservice education of secondary agricultural and science educators who would teach applied biology and chemistry. A literature review provided information on school organization and the various subcultures within the school: overall culture of the school, teacher subculture, and culture of the educational technology. Anecdotal records kept as part of workshops held for secondary agricultural and science educators yielded data to corroborate the literature. A framework for successful inservice education for agricultural and science educators was developed based on the workshop data and the literature. Findings indicated that, as a reform effort, applied academics would require a "bottom-up" approach. Change would come from the individual, not the organization, would be internalized, and would result from seeing students learn. The following recommendations were made: appropriate inservice education for secondary agricultural educators should be implemented using the model; research should be conducted in each state to determine the level of support for appropriate inservice education; and agricultural education departments should begin to infuse the teaching of applied academics into existing teacher preparation programs. (Contains 28 references.) (YLB)

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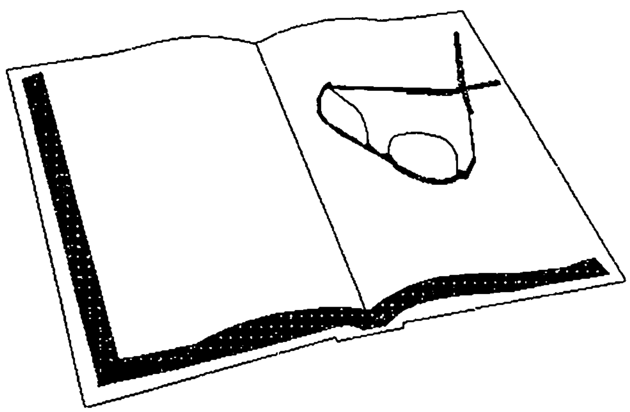

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Abstract

In efforts to enhance learning of science concepts by students not traditionally considered to be high achievers, many states, including Pennsylvania, have attempted to introduce new materials and teaching methodologies to science teachers. However, after much time and expense, the implementation is low. The authors believe this is to be a function of cultures within the school, including the technology itself. As a reform effort, *applied academics* requires a "bottom-up" approach that focuses on change of the individual as a catalyst for organizational change. Otherwise, we will continue doing the same things, in the same way, with a new set of materials.

Introduction

The U. S. Department of Commerce has identified seven emerging technologies that will have an economic impact on our country by the year 2000. Four of these developing technologies have impact for biology and chemistry education: biotechnology, medical technology, advanced polymer composites and thin-layer technologies (US. Dept. of Commerce, 1987). Large numbers of workers will be needed for these industries--workers who have an understanding of basic biology and chemistry concepts and processes. The burgeoning field of health care and related services will require workers with similar knowledge or skills. Today's students, many of them low achievers in science, will comprise the majority of the labor pool for the jobs of the future. Simply mandating they take more traditionally taught science classes will not meet their needs. This "forgotten half" need courses designed specifically for the way they learn--courses that emphasize hands-on learning and application of abstract concepts to their occupational, personal, and community interests (US. Dept. of Education, 1987). This new technology of teaching science is known as *applied academics*.

The goal of *applied academics* has been to serve the mid-50% of the student population, often referred to as the general students or those placed in vocational training. Many of these students do not pursue a four-year postsecondary education. They will usually go to work upon graduation or attend a two-year postsecondary technical training program.

Pennsylvania is one of 32 states that has joined the Center for Occupational Research and Development (CORD) to develop curriculum materials that use a hands-on, applications-oriented approach to teach science. Course materials have adopted instructional strategies recommended by the National Science Foundation, which emphasize the importance of teaching science in the context of major life issues. Addressing occupational, personal, and societal issues, the *applied academics* curricula have adopted an approach consistent with the National Science Teachers' Association's *Criteria for Excellence* (Natl. Science Teachers' Association, 1987). In addition, recommendations relative to both content and effective learning and teaching, as expressed in *Project 2061: Science for All Americans*, have been incorporated into the curriculum (American Association for the Advancement of Science, 1989).

Since 1990, the Pennsylvania Department of Education has embarked on an aggressive inservice program, operated by the Bureau of Vocational-Technical Education, to train science educators in the new educational technology of teaching *applied academics*. However, after many person-hours and thousands of dollars, the implementation rate is very low--about three to four percent of all schools in the Commonwealth have adopted an applied academics curriculum.[1]

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1 Meeting with Tom Bandell, Applied Academics Coordinator, Bureau of Vocational-Technical Education, Pennsylvania Department of Education, September 30, 1993, at University Park, PA.

Purpose and Objectives

The slow adoption of this educational technology may be a function of cultures within the school: (1) the overall culture of the school, (2) the teacher sub-culture, and (3) the culture of the technology. The purpose of this study was to examine technology refusal within the context of applied academics, and, more specifically, *Applied Biology and Chemistry*. Objectives were to:

1. Identify school cultural factors which act as barriers to technology implementation; and,
2. Develop a framework for inservice education of secondary agricultural and science educators who will be teaching *Applied Biology and Chemistry.*

Methods and Procedures

A thorough review of the literature provided information on school organization and the various subcultures. Anecdotal records kept as part of regular workshops held for secondary agricultural and science educators yielded observational data to corroborate the literature. A framework for successful inservice education for agricultural and science educators was developed based on the workshop data and the literature.

Results and Discussion

Early research on educational innovation focused on characteristics of *individuals* who adopt precise and small-scale technical change. However, recent scholars have questioned the limitations of this individualistic approach and have sought to develop generalizations about the change process--generalizations which could be applicable across the broad panorama of educational institutions (Boyd & Immegart, 1977). In this process the significance of the differences in organizational structures of schools, and how those differences may influence technology adoption and change have been largely ignored. There has existed a tacit assumption that adoption of change is somehow congruent with implementation. This, in turn, has resulted in the mindset that people can be rationally persuaded, "group sensitized," or compelled to accept and enact innovations (Boyd & Immegart, 1977; Lee, Dedrick, & Smith, 1991; Guskey, 1986).

Analyses of technology deployment in schools usually describe a lack of substantial impact on the behaviors of students, teachers, or administrators. This lack of impact is seen as a failure of implementation, or as a result of attitude problems on the part of teachers and others. While this belief has some merit, in part it ignores the influence of the innovation on the refusal of the new technology. The implication is that the technology is, therefore, value-free, and has no means to uphold or support the value of the institution into which it is placed (Hodas, 1993). However, teaching technologies are not neutral and they must support or subvert the values of the organization into which they are infused. Hodas (1993) further contends that a failure of the technology to "alter the look-and-feel of schools more generally results from a mismatch between the values of the school organization and those values embedded within the contested technology" (p. 2). Therefore, to explain failure to adopt an innovation within the framework of *applied academics*, conflicts between values and goals of a school and its accompanying teacher subculture, and those imbedded within the holistic educational technology of *applied academics*, work to interfere with implementation of the new curricula and pedagogy. Understanding these organizational subcultures is a key factor in facilitating change. The overall school organization is most important in that its structure usually influences the development and operation of its subcultures.

The School Organization

Schools are organizations and, as such, have systems for communicating and arranging things, as well as a structure for dividing up the work and defining the relationship of people to each other. These "prior arrangements" help prevent constant crisis and allow expeditious, careful handling of most circumstances (Handy and Aiken, 1986).

The school is organized into "learning groups" of children with one teacher. Handy and Aitken (1986) referred to this as a "job-shop" structure, where each unit has its own independent task to do. Yet each class is only a mini-society within the larger society of the whole school--it is here that complications can set in:

> Every society has its own culture, and nothing in education is value-free. Does the class take its values from the teacher or from the group norms or from both? . . . There needs to be some cohesion or conformity for the whole organization, a higher order of things than the class group, if the school is to be more than a collection of (different) families . . . . (p. 15)

As an organization, the school must have a collective will, an agreed purpose behind its structure. This means arriving at a shared set of values and expectations--particularly given that schools are involved in the business of the development and transmission of values. Maintaining professional autonomy and artistic freedom within the confines of the common school goals are often sources of conflict, particularly when the introduction of new educational technologies is due to pressures from external sources (i.e., the Pennsylvania Department of Education). A further complication evolves in the secondary school setting--that of the student sub-group and its reactions to values and pressures from within and outside the school.

The secondary school also has greater *differentiation* between divisions and groups. The major division in the elementary setting is by grade/age. In addition to this division, the high school will also separate students through the course of the day by content specialty areas and choice of postsecondary options. Specialist subject teaching becomes the basis, then, for the secondary school organization, and the aspect of pastoral care which is so prevalent in the early grades is nearly eliminated. Teaching groups tend to be formed in relation to subjects or groups of subjects resulting in several consequences:

- more student groupings;
- less stability and security in the teaching group;
- tendency towards polarization of values (between subjects and levels of courses);

- polarization of expectations; and
- greater differences in motivation among students and staff. (Handy & Aitken, 1986, p. 25)

This differentiation of secondary schools is a necessary consequence of the subject syllabus. The purposeful focus on academic excellence, however, is seen by many as a threat to other values which have long been cherished by our schools--those of respect and equal opportunity for all (Kozol, 1991; Murphy, 1991; Conroy, 1993)--but, reality within the organization is much less than ideal. For example, attitudes develop among people within the organization (staff and students) that some subjects are of greater importance than others. Some courses, classes, teachers, activities and some students, therefore, become more valued than others.

What, then, are the implications of school organizational structure for adoption or refusal of a new educational technology such as *applied academics*? Hodas (1993) maintained that schools are "exempt from nearly every outside pressure which can be brought to bear on organizations that must adapt or die" (p. 3). What may appear as a routine improvement to various external agencies that have encouraged the adoption of the *applied academics* curriculum may be perceived as a serious disruption if the culture must change habits and values in order for implementation to occur (Hodas, 1993). Intrinsic to this situation is the manner in which inservice education in *applied academics* has been carried out in Pennsylvania over a three-year period. A series of one- or two-day workshops designed to initiate change in the beliefs, attitudes, and perceptions of teachers about the applied curricula has not resulted in large-scale implementation. These results reinforce the research of Guskey (1984) and others (Fullan, 1985; Crandall, 1982) in which it was determined that changes in teacher attitudes, beliefs, and commitment to new practices was likely to occur <u>after</u> changes in behavior, not before. Therefore, if the school organization is not willing to endorse or require, and financially support, the adoption of the *applied* *academics* curricula or philosophy, the chance that a teacher will individually change teaching behaviors in the classroom and then seek school or department conformity is very unlikely.

Why would there be organizational resistance, explicit or implicit, to adoption of a philosophy and educational technology which would benefit such a large group of students, and have such a potential economic impact? The answer to this question lies in an examination of two structural features mentioned previously--differentiation and values. By its very nature of subject and ability groupings the secondary school structure prevents and discourages interaction between teachers of different subject areas. In many cases, teachers of different levels of students may also not interact to any great degree. The *applied academics* approach is holistic and requires the integration of various disciplines in order to produce maximum benefits. As an example, the *Applied Biology and Chemistry* curriculum developed by CORD is a set of modular learning materials that integrates the treatment of biology and chemistry as a unified domain of subject matter (CORD, 1990). Potential teachers include not only biology and chemistry teachers, but vocational and technical education teachers as well. In addition, a majority of the activities suggest integration with language arts, mathematics, or social studies instructors to further increase the opportunities for reinforcement of learning. Both of these aspects of the curriculum serve to "de-mystify" the place of the science department in the "important curricula" hierarchy, but also force the organization to change how it approaches planning time, inservice education, allocation of resources, and general fostering of staff relationships.

Students, as well as certain subject-area teachers, have relative "value" within the school organization. With few exceptions, the students who would be enrolled in an *applied academics* sequence would be vocational students or students designated as "low achievers" in science. Indeed, the curriculum materials produced by CORD were designed with these students in mind. The general consensus among science faculty is that these students are undesirable to teach and, as one high school chemistry teacher so aptly stated, she had to be "pulled, kicking and screaming down the hall" to the vocational classroom when informed she was to be assigned to this group.[2]

The question might arise, "How would this value placed on a group of students, as a feature of the school organization, influence adoption of a new educational technology?" Lee, Dedrick and Smith (1991) found that the academic ability of the students whom individual teachers teach is clearly important to teachers' sense of efficacy--the perceived ability to affect students' learning. The significance of this is found in a further review of Guskey's research on teacher adoption of educational innovation. As previously stated, a change in teacher commitment to a new practice is likely to occur after a change in behavior, not before. Guskey (1986) also reported that significant change in beliefs and attitudes of teachers is contingent upon evidence of change in the learning outcomes of their students, which would relate to a change in teacher behaviors.

To summarize this point, unless teachers are motivated, encouraged or required to change their behaviors, they may not have an opportunity to observe changes in student learning outcomes, which will further reinforce the negative stereotypes about the typical abilities of vocational students. Teachers' sense of efficacy will remain low, and it is unlikely they will expend the time and effort to change their behaviors on their own. The science teacher mentioned earlier, who had to be "dragged" to the vocational classroom, provides the best example of this relationship. She was "forced" to adopt the CORD biology/chemistry curriculum. As she gradually began to see changes in learning outcomes, behaviors, and attendance of her vocational students, she became more committed to this applied, holistic delivery of content. In fact, she has become one of the chief proponents of *applied academics* in Pennsylvania, even refusing a recent opportunity to return to the traditional chemistry

2 Anecdotal records, Carol A Conroy. Applied Biology and Chemistry Workshop, State College, PA, October 30-31, 1992.

classroom.[3] A look at characteristics of the teacher subculture provides additional insight into these phenomena.

The Teacher Sub-Culture

The teacher sub-culture is characterized by three major foci: control, autonomy, and time. Two of these, autonomy and time, can be factors in the adoption and implementation of educational technology.

Teacher autonomy, as a norm, stems from the features of school. The beginning teacher does not begin his/her professional career without training and a knowledge of the trade. Almost immediately the notions of the "classroom" and autonomy--control over one's own domain--are reinforced by colleagues. Teachers do not like the idea that anyone could come into this private domain and attempt to tell them what to do. In addition, the physical arrangements of schools foster the notion of autonomy. And, since there is no widely accepted and agreed upon work technology, teachers feel they need the leeway to make decisions about what occurs in their individual classrooms. It can therefore be concluded that autonomy norms are very fundamental to teachers and are very highly valued.

The change to an *applied academics* curriculum presents a serious threat to teacher autonomy in the context in which it is previously described, especially in circumstances in which it is forced. The adoption of the *Applied Biology and Chemistry* program requires a complete change in objectives and teaching strategies. This change includes interaction and coordination with other teachers, involvement of external resource personnel, and use of content to teach processes and skills. At best, the traditionally trained science teacher brings a good content background and a desire to change into this process. However, most teachers participating in the inservice training workshops offered by the authors anticipated changing

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3 Anecdotal records, Carol A. Conroy, September 30, 1993.

materials used in the classroom but see little need to change their own behaviors. Indeed, it appeared difficult for them to conceptualize how they might integrate the students' occupational, personal, or community interests into their content. Few use, or feel comfortable with, collaborative learning strategies and group evaluations.[4] The changes required to implement *applied academics* are thorough enough to interfere with the teachers' comfortable sense of control over what occurs in the classroom. External mandates and forced interaction with vocational teachers and students increase this interference and reduce the sense of autonomy.

Teachers value time because of the role-overload nature of their work. They view as unfavorable the time they must spend away from teaching and preparing to teach--time for clubs, concerts, programs, etc. Changing the way teachers deliver content requires time, as mentioned previously, time which may not be available during the day because of classroom commitments, or at night because of contract specifications or lack of interest. There is also some relationship between time and autonomy--externally controlled demands on a teacher's time reduce autonomy.

Circumstances of teaching demand a lot of teachers for daily maintenance and student accountability. Little time is given back for planning, discussions of a constructive nature, thinking, and just plain rewards and time for composure (Fullan, 1991). A study by Lortie (1975, as reported in Fullan, 1991) described how unwanted innovations might be a source of annoyance--most teachers indicated that time erosion or a disruption of work flow were their major complaints.

This paper has so far examined the specific cultural characteristics of both the school organization and the teacher sub-group that influence innovation adoption or refusal. There is also an interaction of these two cultures that provides a separate, unique influence as illustrated by Hodas (1993). Hodas contends that refusal of a technology is a result of

4 Anecdotal records, Carol A. Conroy. Applied Biology and Chemistry Workshop, Sandy Lake, PA, October 8-9, 1993.

teachers gradually adapting and acquiescing to the values and processes of the organization, not a function of simple resistance to change. He also insists that the culture of the technology, itself, supports and helps encourage its refusal or limits implementation.

The Culture of Educational Technology

Schools, as we know them, are both relatively recent and consciously modeled on that most productive of all technologies, the factory (Hodas, 1993; Tyack, 1974). They can be described as machines--machines set up to convert raw materials (new students) into finished products (graduates, citizens, workers) by the application of particular processes (pedagogy, materials) (Hodas, 1993). This analogy leads to the notion that schools can be "re-tuned" or "re-built" to become more efficient in how they operate. Inherent in this notion are the assumptions that we know what we want schools to do, that what we want is unitary and can be measured, and that it can be affected by regular changes to one or more of its processes. It is therefore presumed that education has technological limits and that better technology will remove them. All curricular, instructional, and material experiences of the school are embraced by this construct of "educational theory."

Educational technologists attempt to make schooling better through manipulation of its objects and processes. This better, more efficient schooling is not the straightforward, value-free entity that it may appear to be. To return to the factory analogy, efficiency is measured by outputs versus inputs. To assume that this relatively simple concept could be transferred to the complex social environment of the school is not realistic. Indeed, our socially situated system of education presents a complex, more contested, and more subjective environment than the factory or business (Hodas, 1993). In order to gauge "efficiency," technologists turn to the one process in schools which can be measured--transfer of information to students. What results is a realization that it takes an awful lot of workers, money and resources to transfer a relatively small amount of information. Therefore, problems with education must be problems of instructional delivery.

The problem with this viewpoint is that education is then viewed as the transformation of information from a repository to a receptacle solely by the "instructional delivery vehicle." The complex social interactions of the student, teacher, and school within society have no influence.

Technologists also concern themselves with standardization. Schools are supposed to produce the same outputs every year. The explicit reason given for modeling schools after factories was the desire for this uniformity of product. The weakest link has long been recognized as the last one--the teacher--the instructional delivery vehicle. For this reason, educational technologists have strived to produce solutions not to aid the teacher but to recast, recapitulate, or replace him/her either with a machine or a teacher-proof curriculum (Hodas, 1993).

> Teachers neither choose the curriculum nor invent the techniques. Rather, teachers follow the curriculum that the state or district mandates and mimic the techniques that educational research validates. This view suggests that teachers are more like workers than professionals because they lack control over what is produced and how it is produced. (Howley, Pendarvis, & Howley, 1993, p. 13)

The experience of the authors with state initiatives toward *Applied Biology and Chemistry* reinforce these ideas. The technology of the "canned curriculum" limits teachers' power and, consequently, their willingness and ability to shape any--including an intellectual--school mission. A reform effort that seems, on the surface, to empower teachers, really leaves them out of the decision-making process (Metropolitan Life, 1985). So, how do the school subcultures subvert change? A look at their interactions can help provide the answer to this question.

Refusal of Technology

Technology can be a factor for change within the school, for both the organizational structure and patterns of practice. These changes can either reinforce or subvert existing lines of power and information. Since schools are composed of varied and diverse groups, often with competing interests, adoption and implementation of technology are two very different things (Hodas, 1993).

With the state *Applied Biology and Chemistry* initiative, two conflicting messages are being sent to teachers. From one perspective, the potential of the new curriculum for enhanced learning by vocational students is emphasized. At the same time, however, teachers are reassured that their positions and roles will not change. To illustrate, the adoption of *Applied Biology and Chemistry* is promoted as the means to "reach vocational students and interest them in science (CORD, 1990)."[5] But, there is little, if any, change within the curriculum, in the mechanics of the teachers' behaviors, the physical structure of the classroom, or the routinization of student paperwork. The fact that few changes are required with the "canned curriculum" produced by CORD and others, has probably worked to reduce the threat they pose. However, teachers do resist them and, more significantly, the pedagogical changes required to adopt and implement the *applied academics* philosophy as taught by the authors in their in-service sessions.[6] This is partly because of the overt or implicit critiques of the teachers' practices and world views, and the accompanying threats to existing principles and practices. Teachers will react, generally, in two ways to the challenge to change: (1) they can ignore or subvert the change or (2) they can co-opt or repurpose it to support their existing practices (Hodas, 1993).

This question of teacher self-definition revolves around anxiety that is generated by their unfamiliarity and perceived incompetence with new ways of doing things. Fear of being embarrassed is a major de-motivator in the acquisition of skills required for use of a new technology (Honey & Moeller, 1990; Kerr, 1991; Sheingold & Hadley, 1990). Hodas (1993) contends that this ultimately leads to a convergence of institutional and individual interests with a foregone effect. The self-selection for teaching of "individuals who do not show

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5 Anecdotal records, Carol A. Conroy. October 30-31, 1992.

6 Anecdotal records, Carol A. Conroy. Applied Biology and Chemistry Workshops, May 14-15, June 15-17, October 8-9, 1993.

interest for ongoing intellectual development" coupled with the tenure system works to nearly "guarantee a teacher corps that is extremely reluctant to attempt change" (Hodas, 1993, p. 12). In addition, the job of school administrators is made much easier in these situations--a population of complacent workers acts as a buffer against change--and there is less pressure to develop creative management skills needed if teachers are to develop new classroom skills.

In the past, teachers controlled perceptions of their expertise and competence by the strategies (or lack of) they employed to control students. Pressure towards competence and the acquisition of new skills is generally not a feature of the school culture or the employment contract. It will come from unexpected areas--from the technology itself and/or from the attempt to retain mastery over students. Administrators and teachers alike will resist this scenario, and the demands on time and management skills it requires.

So, adoption of the CORD *Applied Biology and Chemistry* canned curriculum should be an "easy sell." It complements existing organizational structure and practice models, and signals modernity and standardization (Newman, 1992). However, the curriculum really is a prime example of the non-neutrality of technology. It does not foster many, or even several, types of learning, and continues to utilize the typical sequential laboratory and classroom practices--reading, answering questions, laboratory work, and testing. The best chance this technology has for adoption and implementation is the flexibility it has for fitting existing strictures of classroom practice (Cohen, 1987; Cuban, 1986).

Adoption and implementation of *applied academics* as a philosophy of delivery is another matter. It requires the restructuring of the learning environment so that it is almost instantly responsive to changes in the students' lives and community. It requires that students become actively involved in their own education and, most importantly, it requires a change in the control and order so prevalent in the school environment. However, there is little implementation of either the CORD materials or a new philosophy of delivery.

A Model for Inservice Education

It would appear that there are only two ways to conceptualize a relationship between an introduction of a technology into a school and a substantive change in what schools do and how they do it. First, some technologies can function to bring about practices which are viewed as desirable or acceptable, operationalizing new values which yield fundamental changes in school structure and practices. Secondly, schools might begin to re-evaluate the social purpose they serve, how they accomplish this, and the principles by which they operate. Internal, external, or institutional forces may all work to create adjustments to the inputs available to and outputs desired from schools. If students, parents, and teachers are all pleased with the results of the changes, it would become difficult to sustain repressive features of the school organization. In addition, as the desired "product" of the school changes, over time, the school will have to adjust its norms and processes.

The best framework for teacher inservice education is one which provides reflection, feedback and opportunity to observe student learning outcomes as illustrated in Figure 1.

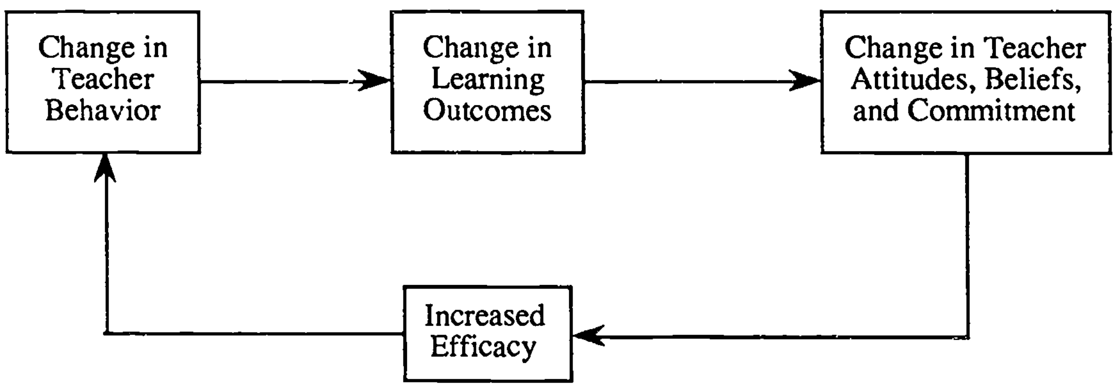

Figure 1. Relationship Between Change in Teacher Behavior and Student Learning Outcomes.

Ideally, teachers would participate in a two to three-day, intensive workshop designed to provide them with the rationale behind the development of and need for the Applied Biology and Chemistry curriculum. This initial workshop would also contain sufficient activities and instruction to enable them to immediately begin use of a few associated instructional strategies and materials. Additional, one-day workshops would be conducted throughout the school year for the purposes of providing reinforcement and new knowledge, teacher sharing, and assessing changes. Both the CORD materials and teacher-prepared materials using standard textbooks would be utilized.

Conclusion

Applied academics as a concept is not new. We have been doing it for years in vocational education. Because of the segregation of students and teachers so prevalent in our school structure, the academic community has been largely unaware of the skills and content imbedded in most vocational curricula. The math and science, or other competencies, required have been discounted because of lack of proper credentialing of vocational educators. With the ever-growing push towards postsecondary education, and emphasis on math and science competence, the traditional vocational education teacher and student have become more "de-valued." Recent federal legislation has increased awareness and appreciation of the role a sound secondary experience can play in preparing young people for the transition from school-to-work, but primarily in the context of "tech-prep" initiatives--preparation for two- or four-year postsecondary technical articulation.

Like most reform efforts, this one will only work using a "bottom-up" approach, unlike the bureaucratically mandated focus now in operation. Change comes from the individual, not the organization, change that is internalized and a result of seeing students learn. Change that is focused more on how we do what we do than what we teach.

It has been stated that teachers need to be motivated strongly to adopt an *applied academics* philosophy. How can change begin with the individual without some "top-down" motivational strategies? Perhaps the answer lies within an examination of those relationships between introduction of a technology and substantive school changes. Schools should re-evaluate the social purpose they serve, and how it is accomplished. If the organization--administrators, teachers, and students--has a goal of student success, and changes are prescribed (i.e., use of CORD or other materials), appropriate inservice delivery, over time, should result in the internalization of the new approach to and philosophy of delivery, increased student achievement, and greater teacher efficacy.

This is not to imply that teachers are solely responsible for change. The organization, itself, must be flexible to allow time for teacher interaction and, surely, must examine how its component groups are compartmentalized. These changes would allow teachers to take control over their individual and, hopefully, group learning environments. The organization and external forces, such as the state, must recognize the dynamics of change and the role each group plays in the process--if true change is the desired outcome. Otherwise, teachers will continue doing the same things, in the same way, with a new set of materials.

Recommendations

Appropriate inservice education in *Applied Biology and Chemistry* for secondary agricultural educators should be implemented using the model illustrated in Figure 1. This can occur for teachers wishing to teach this course for a portion of the day, or for the agricultural educator wishing to integrate applied academics into his/her traditional curriculum. Given the decline of secondary agricultural enrollments in many areas, this would serve to increase the marketability of graduates of teacher preparation programs.

Research should be conducted in each state to determine the level of support for appropriate inservice education in *Applied Biology and Chemistry* as illustrated in Figure 1. The research could be designed as a pilot program to assess differences in adoption of and attitude towards change between program participants and those persons exposed to short-term inservice activities.

With the current emphasis on Tech-Prep and other programs leading to postsecondary education, it is important that agricultural education departments of universities begin to infuse the teaching of applied academics, specifically *Applied Biology and Chemistry* into their existing teacher preparation programs.

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