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ABSTRACT

An overall strategy is reported for updating secondary and postsecondary vocational/technical teachers in the technologies of their teaching areas. It is designed for use by vocational educators and others who provide technological update: local school, institution, and district administrators and boards; teacher educators; vocational/technical professional development leaders; business/industry representatives; and state and federal department of education personnel. The first chapter provides background on the need for the strategy, its development, and the nine essential strategy characteristics. Chapters 2 to 10 each treat one of the generic characteristics of a successful strategy for technological update: structure for action, roles and responsibilities, policy, resources, incentives and rewards, high potential techniques, alternative technique configurations, incorporation of update in programs, and continuing and self-renewing activities. Each chapter presents (1) a rationale for the inclusion of the characteristic, (2) guidelines for implementing the characteristic, and (3) specific details appropriate to the illustration of the discussion. Chapter 11 discusses the implementation of technological update programs at the statewide level and suggests an appropriate structure for administering such programs. Chapter 12 provides related recommendations for action to increase the effectiveness of current efforts to provide vocational teachers with technological update. (YLB)

Research and Development Series No. 242

UPDATING TEACHERS FOR TOMORROW'S TECHNOLOGY: A STRATEGY FOR ACTION

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The National Center for Research in Vocational Education
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FOREWORD

In order to provide high-quality vocational education programs during this period of rapidly changing technology, it is imperative that secondary and postsecondary vocational teachers remain up-to-date in the knowledge and skills of their occupational fields.

Several approaches currently being used to update vocational/technical teachers have been previously studied and described. While some success in teacher update is being achieved through use of each of these individual approaches, large numbers of both secondary and postsecondary teachers remain in need of technological update. Apparently lacking is a strategy or overall plan for effective selection, application, coordination, and management of existing technological updating approaches and creative adaptations of those approaches.

This document presents an overall strategy for meeting the technological updating needs of secondary and postsecondary vocational/technical teachers. It is designed for use by vocational educators and others faced with the problem of providing technological update: local school, institution, and district administrators and boards; teacher educators; vocational/technical professional development leaders; business/industry representatives; state and federal department of education personnel; and others concerned with the design and implementation of programs to update the technical knowledge and skills of teachers.

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Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

This document reports a strategy for updating secondary and postsecondary vocational teachers in the technologies of their teaching areas. The strategy consists of nine generic characteristics identified as essential to the success of programs designed to update teachers. As such, the strategy maximizes known update program facilitators and minimizes known program barriers. Development of the strategy was deemed necessary because of the persistent lack of success of many efforts to provide technological update to vocational teachers, in spite of a well-known repertoire of appropriate techniques available.

The strategy development work drew heavily on the knowledge and expertise of a panel of experts consisting of teacher educators, professional development leaders, community college personnel, statewide program coordinators, and representatives of business and industry. Panel members were chosen collectively to represent a mix of backgrounds and experience in the area of teacher technological update; individual members were chosen on the basis of participation in a successful program for secondary or postsecondary vocational teacher update.

The panel members conferred with project staff in an intensive two-day meeting, comparing their individual experience and knowledge in the area of teacher updating in order to identify constants affecting the process—barriers to the success of update programs or facilitators of such success. Through this inductive analysis of staff and panel members' collective and individual experience in the problem of vocational teachers' technological currentness and in the implementation of successful solutions to that problem, nine essential characteristics of a strategy for technological update were identified:

- The strategy should provide an *organization or structure for action*—i.e., a logical sequence of steps to follow in designing and carrying out technological update programs or activities.
- The strategy should define the *roles and responsibilities* of all the individuals involved—teachers, administrators, department of education personnel, teacher educators, and business, industry, and labor participants.
- The strategy should present *policy statements* to support the roles and responsibilities of those involved and the activities in which they participate.
- The strategy should define and provide the *resources* necessary and available to teachers for participating in activities to gain technological update.
- The strategy should provide *incentives and rewards* to achieve and maintain motivation to participate in technological update activities and incorporate the results into program curricula.
- The strategy should identify and provide a variety of *techniques* by which teachers can gain technological updating.

- The strategy should allow for and provide *alternative and creative configurations* of techniques to best meet the individual needs of teachers seeking updating.

- The strategy should provide for the incorporation of the *knowledge and skills gained in update activities* into the instructional program or course materials.

- The strategy should provide for *continuing and self-renewing activities* to maintain technological update on the part of all involved.

Each of the nine characteristics is discussed fully in the document, with concrete illustrations presented as appropriate on how to implement them.

A statewide implementation model suggests the standardization of administrative arrangements regarding college and university credit, eligible update activities, funding and reimbursement activities, and minimum standards for teacher participation. The model also recognizes the need for arrangements within specific occupational areas regarding needs identification, identification of sources of activities, and scheduling details. Comprehensive planning committtees and occupational area-specific committees at both the state and local levels are recommended structures for implementation of a statewide program of technological update.

Finally, recommendations for further appropriate action are made:

- Assessment of the need for technological update and plans to address this need should be a required part of local operational plans.

- Local operational plans should directly address curriculum update as a necessary part of teacher technological update.

- State operational plans should address the states' roles in planning and support of teacher technological update.

- State and federal departments of education should develop rules and regulations regarding administration of educational legislation to impact specifically on teacher technological update.

- Vocational teacher certification and recertification requirements should be modified to place greater emphasis upon the teachers' currency of demonstrated teaching competence and occupational competence.

- In order to attract and retain highly qualified vocational teachers, salary schedules should recognize years of occupational experience, including time spent in business/industry internships, as well as teaching experience and formal educational preparation.

- A federal program of update grants or fellowships to local districts or individual teachers allowing a variety of high-potential update techniques should be established.

- Tax incentives should be made available to businesses and industries to encourage their collaboration in providing quality occupational internships for teachers and for provision of equipment necessary for incorporating current occupational technology into vocational curricula.

- Occupational currentness should be a major criterion for selection of vocational teachers for "merit pay" or for designation as "master teachers."

- Vocational teachers should be paid to establish and coordinate collaborative arrangements with business/industry to provide work experience and instruction for vocational students in occupational areas in which the local school cannot provide up-to-date instruction due to teacher or equipment limitations.

- Staffing policies and practices in vocational education should be adopted, such as hiring of qualified part-time instructors and/or required, regular, paid business/industry internships for teachers, which will result in teachers more likely to remain current in their occupation.

The information in this document should be useful to vocational educators in a wide variety of settings who are responsible for the task of keeping secondary or postsecondary vocational teachers abreast of today's fast-changing technology: local school, institution, or district administrators; teach · educators; vocational/technical professional development leaders; business, industry, and labor personnel; state and federal department of education personnel; and any others concerned with the design or implementation of programs to provide technological update to vocational/technical teachers.

1. INTRODUCTION

The Need for a Strategy for Technological Update

The currentness of teachers' technological knowledge and skills has traditionally been a major concern in vocational education. Teachers face this concern from the moment they enter the teaching profession; initial certification requirements in the majority of states require beginning vocational teachers to have from three to five years of occupational experience in the technology of their teaching area. Such requirements are intended to ensure that vocational students receive instruction that is up-to-date, that reflects the state of the art, and that will equip them for the reality of the workplace that they will encounter upon leaving the vocational program.

In recent years, however, this concern over teachers' technological currentness has increased greatly. Changes in both the technology of the workplace and the teaching profession have led to a state of affairs that many vocational educators believe to be critical. What are these changes and how have they affected the currentness of teachers' technological knowledge and skills?

The Rate of Technological Change

In the workplace, technological change is now occurring at a rate unprecedented in history. The first and most familiar example of this is the electronic computer. Forty years ago, the computer was a bulky electromechanical contraption—a roomful of vacuum tubes and wiring. Today, the microchip and its attendant technology have so reduced the size of the computer that one can be held in the palm of the hand.

This reduced size and accompanying reduced cost have led to computer applications that have revolutionized the day-to-day workings of many trades and occupations. Assembly-line workers, sales clerks, technicians, draftspersons, health care personnel, bank tellers, agricultural workers—the list of workers who use computers or microcomputers in their daily operations is enormous. Indeed, it becomes difficult to imagine an occupation that is not affected by this now commonplace device.

Change in the Teaching Profession

Change in the teaching profession, on the other hand, centers on personnel rather than on technology. To be sure, the science of pedagogy has made considerable strides in the same forty years. The popular and academic trends in education are familiar to many people—relevance in the curriculum, accountability, competency-based education, lifelong learning, and so on. The salient trend for this discussion, however, is teacher tenure. At the same time that technological change is occuring in the workplace at unparalleled rates, the amount of time that the average secondary or postsecondary vocational teacher has been in the teaching profession—and hence, away from the workplace—is increasing.

This increase in teacher tenure can be attributed to different causes, many of them involving the state of the economy. A sluggish economic growth rate and a high level of unemployment have led many teachers to value the relative job security of the teaching profession. At the same time, forced cutbacks in secondary and postsecondary school budgets and shrinking secondary student enrollments have produced reductions in the teaching staff at many institutions. When teachers are laid off, those with the least seniority (and with the most recent experience in the world of work) go first.

Furthermore, those with least seniority also receive the lowest salaries and are consequently most susceptible to the higher salaries paid for technician positions available in industry. Many educators are, in fact, more concerned about the "teacher drain" than any other aspect of the teaching profession today. It is often said that the best qualified, most technologically current teachers are those most likely to be attracted to industry; this exodus from the school of the best and the brightest further supports the need for updating: secondary and postsecondary vocational teachers have been teaching longer today than before. They are further away than ever before from the day-to-day contact with the technology of the workplace that would allow them to keep abreast of the rapid, manifold changes in that technology.

The Status of Technological Update

In sum, the combination of these changes has had a drastic effect on the technological currency of secondary and postsecondary vocational teachers. Previous project work by Hamilton, Wonacott, and Simandjuntak (1982) investigated the extent and level of teachers' need for technological update. In that study, project staff identified individuals knowledgeable about technological update in their states because of recent research that they or others had done on the need for vocational teachers' update. Individuals in nine states reported their perceptions of the nature and extent of the need for technological update among secondary vocational teachers in their respective states; an additional nine individuals reported their perceptions of the nature and extent of the need for technological update among postsecondary vocational teachers in their respective states. Also reported were the approaches used for technological update in the individual states, the apparent effectiveness of those approaches, and the barriers to those approaches.

Analysis of those aggregated perceptions resulted in some startling estimates: almost half of the postsecondary teachers in those selected states had substantial or critical need for update; almost one-third of the secondary teachers, again in those selected states, had the same level of substantial or critical need. A further finding of this analysis is that the extent and level of need for updating are not likely to decrease. Rather, they are expected to increase.

One response to the need for technological update of teachers is exemplified by John Wiley & Sons. When this publisher developed curriculum materials for word processing and office automation, it found that most instructors were unable to use its texts. Although Wiley's materials were keyed to growth areas in business education, teachers could not adopt materials that dealt with skills that they did not have. To sell its curricular materials, the publisher found it necessary to offer a series of seminars throughout the country to update faculty and provide them with assistance in modernizing their curricula. Building on this success, Wiley and the National Postsecondary Alliance at the National Center are cooperating to offer a series of workshops aimed at upgrading the skills of electronics technology faculty members.

Parallel work further investigated the approaches that are currently being used to provide technological update to secondary and postsecondary vocational teachers (Wonacott and

Hamilton 1983). Descriptions of the approaches in use were gathered not only from the reports mentioned previously but also from a review of the literature and a solicitation of on-shelf program descriptions from selected secondary and postsecondary schools, institutions, and districts. The characteristic features of each reported approach were identified (in order to account for the wide variation in the name given these approaches by the implementing agencies) and each approach was then classified. This led to the identification of six specific delivery techniques that are currently used in programs for technological update.

These six delivery techniques are as follows:

- Work experience internships
- University and college course work
- Workshops, conferences, and seminars
- Industry observation
- Education and industry staff exchange
- Part-time employment

The identifying characteristics of each approach were reported, along with the advantages and disadvantages of each and barriers to and facilitators of each. These techniques are implemented in programs administered by different agencies, ranging from an individual school, institution, or district to a state department of education. Program personnel often report high levels of participant satisfaction with the quality of individual programs or events. However, many program personnel also report a noticeable drop in interest and participation in their events over time.

How are those findings to be explained? On the one hand, secondary and postsecondary educators report high levels of satisfaction with individual update events. (Indeed, this makes perfect sense. Workshops, for example, have been around long enough as an instructional device that their implementation has been practically reduced to a science.) Yet on the other hand, many of these same educators report that teachers seem to lose interest as programs continue; furthermore, they do not attribute this lagging interest to any real decrease in the extent or level of teachers' need for technological updating. They report on the contrary that this need is on the increase.

Barriers and Facilitators

The answer to this question can best be found in an analysis of the barriers commonly encountered in operating technological update programs or events. By and large, a list of these barriers identified by Wonacott and Hamilton (1983) does not contain any surprises. The first barrier is insufficient resources; it takes time, money, and support services to update teachers. The second is motivation; teachers and administrators alike must be aware of the need for update and be convinced of the importance of striving to achieve updating. In particular, teachers must see updating as a personal need. Third, policy, so often a reflection of public awareness, is a crucial area: teachers might need years of occupational experience for initial certification, but this concern for currentness is not as evident in recertification policy. Fourth, access to the means for updating can be a barrier; up-to-date knowledge and skills cannot be conjured out of thin air. Of these barriers, resources and motivation were reported to be the most important by far.

These four barriers commonly operate regardless of which specific delivery techniques are used in a particular update program. No matter what technique is used to deliver up-to-date knowledge and skills, someone still has to pay for it, teachers have to be willing to participate.

administration policy must at least allow it, and it has to be within a reasonable distance. The anticipated increase in the need for technological update among teachers and the lessening of interest among teachers who do participate in a program of update events is most likely attributable to insufficient attention to these barriers. While we are probably safe in taking for granted the idea that delivery techniques are sound and appropriately used, we can equally assume that something is lacking in the context surrounding the use of those techniques.

Strategy versus Tactics

What appears to be lacking is an overall strategy for technological update in which individual delivery techniques can be implemented. All too many efforts toward technological update are in a situation parallel to a classic military cliché—that of the army that wins battle after battle but never can win the war. A military analyst would say that this army's *tactics* must be sound because, after all, it keeps winning the battles; what must be faulty is the *strategy* behind those tactics. Perhaps the army concentrates on capturing cities, when possession of cities does not deprive this particular foe of the ability to defend itself; perhaps by indulging in brutal use of force (e.g., indiscriminate aerial bombing or repressive rule of conquered territory) the army only strengthens its foe's resolve to continue the struggle; perhaps by political ineptitude in the home country the army deprives itself of the means to gain victory. A military analyst would recommend that this army revise its strategy, while probably retaining its current tactics.

A similiar task faces secondary and postsecondary vocational education in the area of technologically updating its teachers. Given that the delivery techniques—the tactics—used in a given update event are sound, it must be that a revised strategy is needed to account for all the factors that affect the provision of up-to-date technological knowledge and skills to vocational teachers. Such a strategy should recognize that it is insufficient simply to make one-time arrangements to get an out-of-date teacher and an up-to-date expert in the same room at the same time, that efforts to provide technological update to teachers will inevitably fail in the long run unless they are supported by appropriate policy and resources, that access to sources of update must be provided if teachers are ever to live up to their responsibility to stay up-to-date in their fields, and finally that it is not teachers alone who have a role to play and a responsibility to fulfill in the task of staying up-to-date.

By the same token, it would not be appropriate to develop a single formula to be applied unfailingly in every technological update program. No single specific formula could hope to account for all the differences in the detail and situation of secondary and postsecondary vocational schools, institutions, and districts across the United States. What would be gained in one situation by the comprehensiveness of the formula would be offset in another by its rigidity. Planners and administrators need instead a set of generic strategy guidelines to follow in formulating a specific strategy of their own that does account for all the detail of their individual situations.

Development of a Strategy for Technological Update

This document attempts to supply generic guidelines by presenting and describing the essential characteristics of a strategy for technological update; these characteristics then constitute a generic strategy for technological update. The document is a result of project work with the following objectives:

- To provide a strategy to teacher educators, school administrators, state department of education personnel, and concerned business, industry, and labor representatives for meeting the technological updating needs of vocational/technical teachers

- To provide tactics with high potential for implementing that strategy

Methodology

In order to formulate these essential characteristics of a strategy for technological update, a panel of experts was assembled to confer with project staff. The members of the panel collectively represented a wide variety of perspectives and experience in the area of technological update. They were drawn from teacher education, state departments of education, two-year postsecondary institutions, and business and industry. (See appendix A for a list of the panel members and their professional positions.) Panel members were given copies of the two documents referred to earlier that had resulted from related previous project work. In addition, project staff had tentatively identified six essential characteristics of the strategy for technological update, six candidate high-potential delivery techniques, and criteria for technique selection; these were given to panelists as well.

In preparation for the panel meeting, panel members and project staff reviewed both extant literature and previous National Center project work that identified both the delivery techniques currently in use to update secondary and postsecondary vocational teachers' technological knowledge and skills and barriers and facilitators that affect the implementation of those techniques. The panel meeting had the following objectives:

1. To identify barriers and facilitators of vocational/technical teacher technological update

2. To analyze the interplay of technological update tactics (approaches), barriers, and facilitators

3. To induce the characteristics of an overall strategy for technological update of vocational/technical teachers

4. To review tactics for technological update of vocational/technical teachers

5. To refine criteria for selection of high-potential tactics

6. To select tactics with high potential for updating vocational/technical teachers in the technology of their teaching fields

While all these objectives were met, the meeting of the panel of experts focused primarily on the identification of the essential characteristics of a strategy. Panel members compared their individual experiences in technological update in order to identify the specific barriers and facilitators that affected update efforts in which they had participated. In addition, each panel member had had the benefit of studying the generic descriptions and specific examples of approaches used for technological update in the previous related products. The generic characteristics of a successful strategy for technological update were induced from this pool of specific individual experiences. Each member offered a personal perspective in the inductive analysis of the factors affecting program success. As a result of this analysis, certain constants were identified: success in individual efforts was always accompanied by the presence of a particular factor or the absence of another factor; equally, the presence or absence of a given factor always accompanied lack of success.

Essential Strategy Chracteristics

The constants identified in this process of inductive analysis were then phrased as generic strategy characteristics. The six tentative characteristics identified in preliminary work by project staff were confirmed as essential by panel members. In addition, three other essential characteristics were identified during the course of the meeting. The final set of nine essential characteristics of a strategy for technological update is as follows:

- The strategy should provide an *organization or structure for action*—i.e., a logical sequence of steps to follow in designing and carrying out technological update programs or activities.
- The strategy should define the *roles and responsibilities* of all the individuals involved—teachers, administrators, department of education personnel, teacher educators, and business, industry, and labor participants.
- The strategy should present *policy statements* to support the roles and responsibilities of those involved and the activities in which they participate.
- The strategy should define and provide the *resources* necessary and available to teachers for participating in activities to gain technological update.
- The strategy should provide *incentives and rewards* to achieve and maintain motivation to participate in technological update activities and incorporate the results into program curricula.
- The strategy should identify and provide a variety of *techniques* by which teachers can gain technological updating.
- The strategy should allow for and provide *alternative and creative configurations* of techniques to best meet the individual needs of teachers seeking updating.
- The strategy should provide for the incorporation of the *knowledge and skills gained in update activities* into the instructional program or course materials.
- The strategy should provide for *continuing and self-renewing activities* to maintain technological update on the part of all involved.

The Generic Nature of Characteristics and Strategy

The reader's attention is drawn once again to the generic nature of both the individual characteristics just listed and the strategy that they constitute. None of these characteristics are thoroughly defined. They do not define, for example, a specific level of economic resources required for a program of technological update, nor do they explain how this level of resources is to be obtained. This approach is in line with the explanation offered previously of the futility of prescriptious to be followed in all situations.

The area of policy serves as a good example of why this is the case. It would hardly be appropriate to prescribe a particular policy statement that should be adopted by all vocational educators—whatever their situation or level of responsibility—planning or implementing a program

of technological update for secondary or postsecondary vocational teachers. No single model policy statement could fit the entire range of specific details that each individual program planner or implementer would need to accommodate. What *would* be of use to such planners and implementers, and is provided in this report, is a set of guidelines setting forth a rationale for policy support of technological update, explaining why such support is needed, and an analysis of the criteria that a given policy for technological update should meet. With that knowledge, individual program planners and implementers can develop a sound policy that will promote technological update while remaining appropriate to the specifics of their particular situations.

Organization of this Report

Chapters 2-10 of this report each treat one of the generic characteristics of a successful strategy for technological update. Each of these chapters presents (1) a rationale for the inclusion of the characteristic, (2) guidelines for implementing the characteristic, and (3) specific detail appropriate to the illustration of the discussion. Chapter 11 discusses the implementation of technological update programs at the statewide level and suggests an appropriate structure for administering such programs. Finally, chapter 12 provides related recommendations for action to increase the effectiveness of current efforts to provide vocational teachers with technological update.

2. CHARACTERISTIC: STRUCTURE FOR ACTION

The first and most important generic characteristic of a strategy for technological update for secondary and postsecondary teachers is that there must be some logical, organized structure in which the action can take place. What are the component parts of the process of bringing and keeping teachers up-to-date with their technologies? What are the tasks involved in attaining this goal?

The process of keeping teachers up-to-date consists of four tasks:

1. Identify the need
2. Develop a plan of action
3. Implement the plan of action
4. Evaluate the implementation of the plan

Each of these four tasks is essential to the overall updating process. Taken together, they constitute a structure for the overall process of technological update that, while hardly revolutionary, is highly useful. In fact, the four tasks very much resemble the basic steps involved in any process of instruction. They are appropriate to the process of technological update because that process, in its most basic sense, is one of instruction. A closer look at each of the four tasks will reveal how they apply specifically to the process of technological update.

This four-part analysis of the process discussed in this section is not sacred in and of itself. There is no magic, of course, in organizing or structuring the actions involved in the process of technological update into exactly four tasks. The merit of this analysis and the important point to consider is the essential nature of each of the generic tasks contained in the overall process: identifying specific needs for update, planning action to address those needs, carrying out the action planned, and evaluating the effectiveness of the action taken. The number of discrete tasks in the process of updating teachers' technological knowledge and skills could be open to debate; the logic and sequence of the tasks involved in the process is not.

Identify the Need

As in any effort that aims to instruct, the first essential step in technological update is to identify the exact need for instruction. No program of technological update will be successful if it attempts to deliver instruction that is not perceived by teachers to be needed—that is not relevant. To ensure that instruction offered is needed and relevant, the instruction must take into account the following:

- The state of the art in the different technological areas
- Levels of worker competence required by employers

- Teachers' current state of knowledge and skills
- Specific areas in which teachers need updating

Many program planners and implementers have learned the hard way the necessity for identifying teachers' individual needs for update. All too often, programs of update activities for secondary or postsecondary teachers have been planned on the basis of what is available instead of what is needed. Teachers who participate in such activities are usually quick to voice their dissatisfaction with them and with future activities planned as part of the same program. Sitting through an eight-hour workshop on a topic entirely outside one's teaching area or not relevant to one's individual needs is much more likely to discourage further participation than to encourage it. Furthermore, lack of awareness on the part of teachers of the need for update was one of the most frequently reported barriers in previous investigation (Hamilton, Wonacott, and Simundjuntak 1982, p. 45).

The State of the Art and Levels of Competence

The first factor to be identified is the state of the art in the technologies in question. Specific information must be gathered on the processes, operations, machinery, and equipment in use in the workplace. Also needed is specific information on the levels of competence needed by beginning workers to function in this technological setting. What knowledge and skills do employers require of their beginning workers, given the technology used in local businesses and industries?

There may be, of course, considerable differences between the state of the art of the technology in the workplace and the levels of beginning employee competence needed by employers. As an example, clerical offices of a given employer may represent the very latest in office practices; perhaps all document production is done on word processors—the office might not contain a single conventional typewriter. The employer, however, may or may not want beginning workers that have received specific training in how to operate word processors. The employer may be quite content to have beginning employees who have had basic knowledge of business document format and basic keyboard skills; the employer might prefer to give beginning employees specific instruction in operating the actual office equipment. The same logic applies to different technological areas as well.

It is important to note that information on both the state of the art and levels of employee competence must ultimately come from one source—potential employers in business and industry. The word-processor-equipped office setting is irrelevant to the local situation if local businesses and industries still have offices full of conventional typewriters. There is something to be said for secondary or postsecondary teachers being aware of the cutting edge in the technology of their teaching areas, of course. What teachers really need, however, is precise knowledge of the specifics that their students will encounter in working for employers and the preparation that students will need for those specifics.

Teachers' Current State and Need for Update

The other factor to be identified is the current level of teachers' technological knowledge and skills. What technological processes and operations are taught in teachers' programs? What equipment and machinery are students taught to use in the classroom or laboratory? Are these the same as the processes, operations, equipment, and machinery that students are likely to encounter

in the workplace? If they are different, what exactly are the differences? What knowledge and skills do teachers have that are not reflected in their curricula?

The difference between the knowledge and skills that teachers actually have and those required of them by virtue of the technology in place in the world of work tells program planners and implementers how out-of-date teachers are. It is important to remember, however, that teachers, whether secondary or postsecondary, may not need to gain all the knowledge and skills required to function in state-of-the-art technology. The levels of competence that potential employers require of beginning workers is a more precise indicator of the actual updated knowledge and skills that teachers need to acquire. Again, "cutting edge" knowledge and skills may be nice and even appropriate in some cases, but what teachers *need* is the specific knowledge and skills that will prepare students for the expectations of the world of work. This is, in fact, the definition of technological currency, which is the goal of technological update programs: the specific technological knowledge and skills that teachers need to prepare their students to perform the tasks expected of beginning workers by potential employers in the area.

Individual Needs and System Needs

Policymakers and program planners also need to take into account that needs identification operates at two levels: the individual teacher and the overall system, whether the system comprises a single secondary or postsecondary school or institution, multiple schools or institutions making up a secondary or postsecondary district, or a mixture of such schools, institutions, and districts in a larger geographical area served by a higher-level agency (i.e., a state department of education, state or regional professional association, or teacher education institutions). Individual teachers must identify their own specific needs for updated knowledge and skills. This identification forms the basis for their future actions in acquiring update. Individual teachers can then carry out specific activities that will meet their particular needs for updating.

An overall program designed for numbers of either secondary or postsecondary teachers, on the other hand, will concentrate on the needs of the system as a whole. If a series of workshops is being planned, for example, the number of teachers who need updating on a particular topic should be considered. A given workshop that would meet the needs of a large number of teachers would be cost-effective and therefore appropriate; the same workshop would be inappropriate if it met the needs of only a single teacher or small number of teachers. For the latter case, a more appropriate system-wide approach would be individual activities (e.g., work experience internships) to meet the needs of the single teacher or small number of teachers.

Develop a Plan of Action

Once individual and system-wide needs for updating are identified, a plan of action must be developed to meet those needs. Such a plan should be relevant to teachers' needs—it must offer the specific instruction that will bring teachers up-to-date in their technologies. It should be realistic; while perfection maybe possible, the plan must enable teachers to make significant and substantial progress toward technological currentness. Finally, the plan should be cost-effective. On the one hand, scarce resources should not be devoted to expensive activities that will benefit only a few teachers; on the other hand, teachers with unusual needs should not be ignored, even though they be few in number.

The importance of planning specific activities to meet the identified needs for updating should

not be underestimated. Previous efforts to update teachers that have relied exclusively on a statement of teachers' professional obligation to remain up-to-date and the hope that teachers will fulfill that obligation have been largely unsuccessful. More than one administrator has come to realize that teachers are much more likely to participate in a specific inservice activity if a program with specific goals is prepared and offered than if they are to carry out, entirely on their own initiative, the whole series of tasks involved in technological update. Like any other kind of instructional activity, technological update is most effective when specific activities are planned to meet specific needs and bring meaningful and valued rewards.

The steps in developing the plan are relatively few and simple. First, *sources of update must be identified*. One obvious place to look for these is in local businesses and industries. Work sites and contact persons can be identified that can provide teachers with the experience they need in current technology. Industry resource persons available to offer workshops or other events away from the workplace could also be identified. Other sources of update to be found in business and industry could be print or audiovisual instructional materials. Local universities and colleges may also have personnel or instructional materials that could serve as sources of updating.

Second, *activities must be identified and planned* that will link teachers with these sources of update. A delivery technique must be chosen for each activity envisioned; arrangements must be made for implementing that technique; questions of location, cost, number of participants, and specific content to be covered must be settled. Furthermore, if a quantified system of recertification or staff development credits is used, credit values must be assigned to the particular activities planned. A similiar procedure must be followed if college or university credits are to be awarded for participation in update activities. If activities are planned and carried out by agencies that do not award such credits (e.g., a state division of vocational education, local board of education or board of trustees, or a professional teachers organization), then that agency needs to work out cooperative arrangements with a college or university to award credit. Third, *a system to evaluate the effectiveness of activities to be implemented must also be designed* at this time.

When a program of activities is planned to meet system-wide needs, explicit provision should be made for arranging activities for teachers whose individual needs are not met by the activities planned. Such teachers should be informed of how they can identify sources for the updating that they need, what kinds of activities they can arrange and how they can arrange them, and what the details are for the administration of these activities. If specific approval is required for these or other supplementary activities, the details of the approval process should be included.

Finally, the activities planned must be promoted. Promotional efforts do not need to be expensive and done by professional advertising agencies. However, they should ensure that all teachers served by the program planned are made aware of the details of the activities. Information should be disseminated on the dates, times, and locations of activities, the content to be covered, possible reimbursement for out-of-pocket expenses, released time provided, credits awarded, or any other administrative details. In addition, it is best to disseminate this information directly to teachers—the information is most likely to arrive in teachers' hands and have a positive impact on them in this way. A program contact person should be named, with address and telephone number given for inquiries.

Implement the Plan of Action

Implementing the plan of action developed for technological update is the next step to be undertaken. In this very important step, teachers participate in activities that they have identified

as relevent to the r own individual needs for updating. Upon completion of update activities, the results of updating—new technological knowledge and skills—are then incorporated as appropriate into program curricula.

In many respects, the simplest step of the entire process of technological update is the implementation phase, during which teachers participate in the activities that have been planned. At this point, the administrative and logistical details of these activities will have been arranged and teachers will have identified specific activities that will meet their own specific goals. Then the plan that was developed in the second step of the process is simply implemented.

However, the final phase of plan implementation is more complex. Incorporating the results of update activities into program curricula is a critical phase of the update process. Although hardly overwhelming (teachers do update their program curricula as a standard part of their duties), incorporation cannot be realistically anticipated or planned until after the activities have been completed. Logically, of course, the incorporation of the results of update into program curricula is a vital part of the process; it would be pointless for teachers to put time and effort into acquiring up-to-date knowledge and skills and then keep them secret. A further explanation of the importance and process of incorporating update results into program curricula is found in chapter 9.

Evaluate the Implementation of the Plan

Finally, as in any instructional effort, the final step in the process of technological update is to evaluate the effectiveness of the effort. Hence, the same sort of wisdom should be observed in evaluating a technological update program as would apply to any kind of program evaluation.

Formative evaluation should occur as the program activities take place. Participants' reactions to individual activities can be gathered on the appropriateness of content and execution. Suggestions can be solicited on possible improvements to planned activities. This feedback should then be used to improve subsequent activities planned but not yet carried out.

In addition, summative evaluation should be conducted on the long-term effects of an update program. Teachers' incorporation of update results into curricula should be monitored to ensure that incorporation does indeed occur. Follow-up activities would gather feedback from both employers and former students on the appropriateness of content (knowledge and skills) incorporated into program curricula.

One important evaluation guideline to follow is that evaluation, although often considered the final step in an instructional program, never ends. The purpose of evaluation is to identify shortcomings in the program, improvements to rectify those shortcomings, and strengths of the program to be retained. These judgments then form the basis for further development of the program, thus starting the cycle again. Evaluation occurs in its natural place in this new cycle, resulting in another new cycle. Thus, each round of evaluation furnishes an additional set of data from which judgments are made about future developments.

3. CHARACTERISTIC: ROLES AND RESPONSIBILITIES

More than one program or effort to provide teachers with up-to-date knowledge and skills has failed to achieve any long-term impact because the responsibilities of all parties involved were not clearly outlined. It is simply not realistic, for example, to include a statement in an institution's staff development policy that teachers have a professional obligation to keep up-to-date with the technology of their teaching area—and leave it at that. Teachers may well have an obligation to work toward this goal but there is little real hope that they will achieve this goal if they are left to their own devices or are asked to proceed entirely on their own initiative.

However willing teachers may be to live up to this sort of professional obligation, they need leadership, guidance, and support for their efforts. They cannot be expected to shoulder the entire responsibility for the task of staying up-to-date. By the same token, the argument that it is administrators' responsibility alone to make updating occur—that individual teachers are powerless to move unless someone else makes all the arrangements, pays all the expenses, and releases them from teaching duties to attend events—does not bear up under close scrutiny. No single agent involved in the process of technological update bears the whole responsibility for making the process work.

Any program or effort to provide technological update to teachers, then, should begin with a definition of the responsibilities of all the agents involved. This is the second essential characteristic of a strategy for technological update. Who are the agents involved in the process of updating secondary or postsecondary teachers' technological knowledge and skills? What responsibilities do those agents have? What other roles might they play, in addition to fulfilling their individual responsibilities?

The Agents

The agents involved in the process of technological update are, in the simplest terms, all those involved in the enterprise of vocational education. It is not only teachers who figure in the process; they are indeed the natural focus of efforts toward update, but they do not bear total responsibility in this area. Nor, on the other hand, can the entire burden of providing technological update be shouldered by the bureaucratic superstructure of vocational education: the state and federal departments of education might well exercise leadership in update efforts, but they cannot effectively impose update from on high by an act of will or administrative fiat.

Education in the United States has a long history of local and state control. The division of powers outlined in the federal constitution, which allocates responsibility for education to the states, has never been substantially altered. The federal Department of Education has in recent years assumed increasing responsibilities in leadership and research; further, it has backed its leadership by some federal funding of education. However, this federal role has not seriously impinged upon the more basic control of education exercised locally.

Thus, those involved in technological update, like those involved in almost all areas of vocational education, include all those individuals and groups who share some responsibility for vocational education:

- Teachers (both secondary and postsecondary)
- Teacher supervisors (both secondary and postsecondary)
- School administrators (both secondary and postsecondary)
- Local boards of education and boards of trustees
- Advisory committees
- Business and industry
- Professional and trade associations and labor
- Colleges and universities
- State advisory committees
- State divisions of vocational education
- State boards of education
- National Advisory Council on Vocational Education
- Office of Vocational and Adult Education

Roles and Responsibilities of the Agents

When multiple agents are involved in the operation of a single process, there must be some explicit division of functions among them. Without clear guidelines for collaboration and cooperation, each agent is likely to assume responsibility for action at his or her own discretion and for his or her own reasons. Inevitably, areas of responsibility will overlap, decisions will be made at separate points with conflicting results, work will be duplicated, and general inefficiency will ensue. Failing definition, spheres of responsibility tend naturally to move toward the personal interests and skills of the individuals occupying those spheres. Our decentralized system of education further aggravates this fragmentation of responsibilities. Lacking a clear assignment of specific responsibilities to each agent in the process of technological update, it becomes all too easy for any individual agent to avoid the responsibility for a task that is difficult, distasteful, or costly to perform.

Generic Responsibilities

The basic functions or responsibilities of the agents involved in the process of vocational education are prescribed by law, policy, tradition, and practicality. We can examine these generic responsibilities briefly to identify how they apply to the process of technological update.

Teachers. The basic function of secondary and postsecondary vocational teachers is to provide instruction to prepare their students for the realities of the world of work. A necessary corollary of this function is the responsibility of teachers to ensure that their instruction is relevant and up-to-date. To fulfill this responsibility, teachers must themselves possess up-to-date knowledge and skills in the technology of their teaching area. Hence, this basic function of teachers leads to a general statement of their responsibility in the process of technological update: to assess their own need for technological update and to participate in activities to gain up-to-date knowledge and skills in their technical area.

Teacher supervisors. As their title implies, supervisors are responsible for monitoring the quality and delivery of instruction offered by the secondary or postsecondary teachers under their

supervision. One aspect of this function is to assist teachers in identifying ways in which the performance of their teaching duties could be improved; further, supervisors then go on to guide teachers in identifying and carrying out activities to effect those needed improvements. As these functions are transferred directly to the area of technological update, supervisors are called on to assist teachers in identifying both their needs for updating and the activities that will meet their individual updating needs and to assist teachers in carrying out those activities.

Local administrators. The function of secondary and postsecondary administrators in the delivery of vocational education is to provide the resources, support, leadership, and management necessary for teachers to deliver instruction. Like supervisors, they bear some responsibility for quality in the provision of instruction under their aegis. Their responsibility in the process of technological update is to ensure that teachers are able to participate profitably in update events by providing, again, resources, support, leadership, and management.

Local boards of education or boards of trustees. Local boards of education are a link between the community as a whole and secondary vocational education; local boards of trustees are a link between the community and postsecondary vocational education institutions (e.g., community colleges, technical colleges). These boards represent community interests to vocational educators and, at the same time, the interests of vocational education to the community. In doing so, the boards establish policy and priorities at the local level, allocate resources according to those policies and priorities, and monitor the use of allocated resources by teachers and administrators in carrying out established policies and priorities. The function of these boards in the process of technological update, then, is to establish policy and priorities concerning technological update, allocate resources to updating, and monitor efforts undertaken to provide updating.

Advisory committees. In the basic scheme of vocational education, advisory committees act as a link between vocational educators and the reality of the world of work. They act both as information brokers, offering counsel and input to secondary and postsecondary programs, schools, and institutions, and as advocates of vocational education to local employers and the community at large. As the closest formal contact between vocational educators and business/industry, they are the most logical source of information on business/industry needs in the area of update—the current state of the art in different technologies, levels of competence required of student program graduates, and hence, the levels of knowledge and skills required of teachers. They can also communicate potential sources of update to educators and advocate business/industry cooperation with teachers as they seek update.

Business and industry. The function of business and industry in the provision of secondary or postsecondary vocational education is in essence the same as that of advisory committees. The salient difference in their functions is that advisory committees are simply the *first* point of contact between vocational educators and local businesses and industries. Whereas advisory committees are the first formal contact point, business and industry are the ultimate source of the world-of-work information that advisory committees transmit. Whereas advisory committees identify and promote business/industry provision of update sources, actual businesses and industries cooperate by providing those sources. Hence, the responsibility of business and industry in the process of technological updating is to provide the benchmark against which secondary and postsecondary teachers can measure their own currentness and then to make available to teachers the sources of that currentness.

Professional and trade associations and labor. The key to the function of these organizations in the provision of vocational education lies in the constituencies that they serve. Each of them serves an audience of interested parties—teachers, employers, or workers. Each has as its overall

goal to promote the interests and better the condition of the members of its constituency. Each functions as an advocate of its constituency by providing information to vocational educators that will allow intelligent and sensible planning and implementation of secondary and postsecondary vocational education programs. The function of these organizations in the process of technological update parallels this basic function: to provide information needed (e.g., state of the art, levels of competence required in the workplace, sources of update, the quality of program graduates) for teachers to work realistically to acquire up-to-date knowledge and skills in the technologies of their teaching areas.

Colleges and universities. Colleges and universities have a twofold function in the provision of vocational education: teacher education and research and development support of educational processes. They train the secondary teachers who provide much of vocational instruction; they develop, test, and refine the techniques and methodologies that both secondary and postsecondary teachers use in providing instruction. The same "brain trust" functions translate well into the area of technological update. Colleges and universities have a responsibility to conduct the research and development needed to support the methodologies of technological update. In addition, the responsibility of colleges and universities to provide instruction carries over into technological update—they have a responsibility to assist in assessing teachers' needs for updating and in planning and conducting workshops, seminars, conferences, and other course work designed for technological update.

State advisory committees. The function of the state advisory committees parallels at the state level that of the local advisory committees at the local level. These committees act in general as a communication link between the state boards of education and the business and industry of the states. Their responsibility in the process of technological update is to provide information on the needs of business and industry (e.g., state of the art, levels of competence required) and business and industry resources that could help to meet those needs, to act as an advocate for vocational education with business and industry, and to recommend policies and priorities bearing on technological update to the state boards of education.

State divisions of vocational education. Within the state departments of education, the state divisions of vocational education are responsible for implementing the policies adopted by the state boards of education. Their role in implementation consists largely of leadership, identification of resources and priorities, provision of inservice activities for teachers, and interpretation of federal and state mandates for local program leaders. Given their statewide function, they can broker information, putting local leaders in contact with one another and with other resource persons. Finally, state divisions often act as advocates of the interests of vocational education in the state political arenas. Once again, these responsibilities translate neatly into a statement of the function of the state divisions in the process of technological update: to provide leadership, identify resources and priorities, interpret mandates, and broker information to implement statewide policy for technological update; to coordinate or to plan and conduct technological update programs and activities; and to act as advocates for update policy in the political arena.

State boards of education. The state boards of education (or in some states, the state boards of vocational education) are the premier policy-setting agencies for vocational education. Their main function is to determine, with appropriate advice and input from other interested parties and agencies, policy and priorities to attain the goals of vocational education within their jurisdiction. In addition, they often develop and advocate legislative proposals to support and implement those goals. In the process of technological update, then, they would have responsibility for establishing policy and priorities at the state level bearing on technological update and for working in the political arena to support those policies.

National Advisory Council on Vocational Education. This body is the national counterpart to the state and local advisory committees. Its function is the same applied at the national level—to act as an information link between federal education personnel and the national business and industry community and to act as an advocate for the interests of vocational education in the national political arena. These same responsibilities transfer to the process of technological updating of teachers.

Office of Vocational and Adult Education. This office sets and implements rules, regulations, and guidelines based on federal legislation for vocational education at the national level. It collects and evaluates evidence upon which to base policy decisions, develops guidelines interpreting federal legislation, implements programs to carry out policy decisions, and acts as an advocate for vocational education in the legislative process. The office would function in the same manner in the process of technological update—assembling information, establishing policy and programs, and advocating legislative proposals to support technological updating at the national level.

Defining Specific Responsibilities

Any specific program being implemented to update vocational teachers must have the responsibilities of agents more specifically defined. The basic explanation of functions and responsibilities just presented serves only to introduce the roles to be played by the agents involved in the process of technological update. Consequently, those planning or implementing a program of technological update for secondary or postsecondary vocational teachers need to include, as a part of their individual, specific strategy, a comprehensive definition of the specific responsibilities of all agents involved in the process.

One such definition of agents' responsibilities is presented in table 1. This table outlines an ideal allocation of responsibilities across the various agents involved in the process of technological update. Specific statements describe the responsibilities of each agent in each of the tasks in the overall process of technological update.

A brief examination of this outline of responsibilities will reveal that many of the statements represented describe only the task to be accomplished without prescribing particular means to use in so doing. The teacher, for example, is to "assess his/her own needs for update." This assessment could be done in a number of different ways—very formally or relatively informally, by use of a paper-and-pencil instrument or through conversation with current practitioners, and so on. The important point, of course, is that a realistic needs assessment must occur. In our generic strategy, how this is done matters relatively little, so long as the end result is that teachers have identified specific knowledge and skills that they need to gain.

An individual developing a specific strategy for use in updating a particular set of vocational teachers, however, would very likely identify one or more specific means to be used in needs assessment. Knowledge and skill inventories for the various occupational areas could be developed or obtained for teachers to use, for example. Thus, when defining specific responsibilities for update, program planners and implementers would flesh out the generics of the outline presented by the specific detail they have chosen for use in their individual situations.

Additional Agent Roles

In addition to the responsibilities described in table 1, different agents might play other roles in the process of technological update. Colleges and universities, for example, do not have sole

TABLE 1

ROLES AND RESPONSIBILITIES OF THE AGENTS IN TECHNOLOGICAL UPDATE

	Identify the Need	Develop a Plan of Action	Implement the Plan of Action	Evaluate the Implementation of the Plan
Teacher	• Assess his/her own needs for update	• Develop his/her own plan to meet identified needs • Participate in the development of a system-wide plan	• Implement activities contained in his/her plan • Apply updated knowlede and skills in the classroom	• Establish criteria of quality and content for evaluation • Evaluate results of his/her own update activities • Participate in system-wide evaluation
Supervisor	• Facilitate individual and group teacher assessment • Maintain liaison with business and industry to determine their needs • Articulate needs of individual teachers and system-wide needs expressed by administrators • Demonstrate commitment to technological update	• Assist in the development of individual and system-wide plans • Demonstrate commitment to technological update	• Ensure teacher and school accountability for application of update results • Demonstrate commitment to technological update	• Facilitate indivdual and group teacher evaluations • Offer constructive criticism of evaluation efforts • Identify and support improvements indicated by evaluation • Gather individual evaluation data for communication to higher administrators • Demonstrate commitment to technological update
School Administrator	o Interpret and communicate school/system needs to those below • Act as data resource on technological update needs • Set priority for technological update • Provide resource (time, money, support staff) for needs identification • Demonstrate commitment to technological update • Provide leadership in technological update • Ensure appropriate use of advisory committees/councils	• Provide resources (time, money, support staff) for plan development • Demonstrate commitment to technological update • Set priority for technological update • Provide leadership in technological update • Ensure appropriate use of advisory committees/councils	• Provide resources (time, money, support staff) for implementation • Demonstrate commitment to technological update • Set priority for technological update • Provide leadership in technological update • Ensure appropriate use of advisory committees/councils	• Provide resources (time, money, support staff) for evaluation • Demonstrate commitment to technological update • Provide leadership in technological update • Ensure appropriate use of advisory committees/councils • Ensure accountability for application of update results • Monitor evaluation process methodology • Disseminate the results of evaluation to appropriate parties • Set priority for technological update

TABLE 1 – (continued)

	Identify the Need	Develop a Plan of Action	Implement the Plan of Action	Evaluate the Implementation of the Plan
Local Board of Education or Board of Trustees	• Collect information from Advisory committees, teachers, supervisors, and administrators on which to base policy decisions • Establish local policy for technological update • Establish funding priorities for technological update • Interpret and communicate system needs to the community	• Review and approve proposals for system-wide plan • Promote community cooperation in plan development	• Monitor plan implementation to ensure quality and appropriateness of actvities • Monitor application of update results in program curricula	• Monitor evaluation efforts to ensure that evaluation is appropriate and comprehensive • Ensure that evaluation results are incorporated in subsequent program planning
Advisory Committee(s)	• Identify and communicate the state of the art to educational personnel • Identify business/industry needs for levels of competence • Supply labor market information	• Identify potential sources and contacts for update activities (sites, people) • Participate in advisory capacity during plan development	• Promote business/industry cooperation in providing sources for update (sites, people)	• Participate in evaluation efforts as appropriate • Make data-based recommendations for program improvement • Assist in determining the impact of update activities
Business & Industry	• Identify levels of employee competence needed • Identify the state of the art • Supply labor market information	• Identify sources of technological update (sites, people, equipment, money, print/ audiovisual instructional materials) • Provide evaluation criteria • Act as information resource in plan development	• Provide sources of update (sites, equipment, instructors, supervision, money print/audiovisual instructional materials)	• Provide information on the quality of program graduates • Participate in formative and summative evaluation as appropriate • Apply evaluation criteria for "reality check" (theory vs. practice, currency, future state of the art) • Provide information on training quality and methodology as possible • Provide data on the impact of update activities

TABLE 1–Continued

	Identify the Need	Develop a Plan of Action	Implement the Plan of Action	Evaluate the Implementation of the Plan
Professional & Trade Associations & Labor	• Identify knowledge, skills, and standards required for needs identification • Identify levels of employee competence needed • Identify the state of the art • Supply labor market information	• Promote the development of a plan of action • Identify sources of technological update (sites, people, equipment, money, print/audiovisual instructional materials) • Provide evaluation criteria • Act as information resource in plan development	• Provide sources of update (sites, equipment, instructors, supervision, money, print/audiovisual instructional materials) • Provide update events	• Provide information on the quality of program graduates • Participate in formative and summative evaluation as appropriate • Apply evaluation criteria for "reality check" (theory vs. practice, currency, future state of the art) • Provide information on training quality and methodology as possible • Provide data on the impact of update activities
Colleges & Universities	• Develop methodology and tools for needs identification systems • Provide research and development services as appropriate and possible • Provide assistance in needs identification process as appropriate • Conduct needs assessment in response to demand	• Provide assistance in plan development (all kinds) as appropriate • Provide research and development services as appropriate and possible • Disseminate information on potential sources of technological update	• Carry out update events as appropriate • Develop or provide leadership in developing tactic-specific guidelines for implementation and evaluation • Conduct and synthesize research and development on implementation as requested	• Provide leadership in evaluting all phases of update programs
StateAdvisory Committees	• Act as communication link with the state board • Recommend appropriate policies and priorities • Identify and communicate the state of the art to state educational personnel	• Identify potential sources and contacts for update activities (sites, people) • Participate in advisory capacity in plan development	• Promote business/industry cooperation in providing sources for update (sites, people) • Support legislative proposals to implemnt technological update programs	• Participate in evaluation efforts as appropriate • Make data-based recommendations for program improvement • Assist in determining the impact of update activities

TABLE 1 (continued)

	Identify the Need	Develop a Plan of Action	Implement the Plan of Action	Evaluate the implementation of the Plan
State Advisory Committees (continued	• Identify business/industry needs for levels of competence • Supply labor market information			
State Division of Vocational Education	• Interpret federal and state mandates impacting on staff development • Identify priorities for technological update (program areas and specialties) • Identify financial resources available	• Provide leadership in developing state-wide strategic plan • Provide cosultant service to others in plan development • Furnish information resources for planning • Collect and disseminate otherwise unavailable evaluation results in a nonprescriptive manner • Provide financial resources for plan development as appropriate	• Co..tract for provision of events and training • Attend events to monitor quality of instruction, get to know teachers and experience their situation, cooperate, interact, and act in broad-based manner • Support legislative proposals to implemet technological update	• Participate in evaluation to ensure objectivity and accountability
State Board of Education	• Collect information from • State advisory committee, state department/division, and others on which to base policy and priorities • Establish policy and priorities at state level	• Review, approve, and act on state-wide proposals from state department/ division	• Develop legislative proposals to support and implement technological update (including the provision of financial resources, whether available in existing budgets or called for in legislative proposals)	• Review evaluation data and make informed decisions on that basis

TABLE 1 (continued)

National Advisory Council on Vocational Education	• Collect and present evidence on the national need for technological update • Recommend national policy and priorities to address the need for technological update • Develop legislative proposals with categorical funding provisions to implement programs for technological update. • Support legislative proposals with categorical funding provisions to implement programs for technological update • Act in an advisory capacity in the planning, implementation, and evaluation of national programs for technological update
Office of Vocational and Adult Education	• Evaluate available evidence to determine national need for technological update • Establish national priorities to address the need for technological update • Support legislative proposals with categorical funding provisions to implement programs for technological update • Develop and implement rules, regulations, and guidelines to interpret federal legislation impacting on technological update • Plan, implement, and evaluate national programs for technological update • Evaluate the impact of national efforts in technological update

responsibility for providing activities that will update teachers' knowledge and skills; that responsibility is shared with business and industry. However, many colleges and universities provide extensive programs of such activities. This is a role that colleges and universities can legitimately play, even though it is not their sole function.

For that matter, local leaders (e.g., school or district administrators) may wish to take action to update their teachers while personnel at higher levels are still involved in planning and organizing a more comprehensive program of technological update. In that case, local leaders might assume some of the responsibilities of these other personnel on an ad hoc basis—establishing a local policy to support an update program, for instance. By the same token, two or more local schools, institutions, or districts might join forces to achieve essentially similiar goals in an update program, exercising leadership beyond that required by a strict interpretation of their individual responsibilities.

4. CHARACTERISTIC: POLICY

The Need for a Policy

Like other endeavors in vocational education, efforts to provide teachers with technological update need to be backed by statements of policy. These statements form an essential part of any strategy for technological update, as they are the formal expression by a competent body of the goals to be achieved and the procedures to be used to achieve them. A general policy stating goals and procedures becomes the foundation on which agents at all levels base their own decisions, priorities, and actions in the process of technological update.

Ideally, policy statements supporting technological updating of secondary and postsecondary vocational teachers are developed and put in place at the local, state, and national levels, by leaders at each of these three levels as they exercise their role of determining the overall goals of vocational education. Agents at each level need to formulate goals and procedures appropriate to their spheres of responsibility in the process of technological update.

Desirable Qualities of a Policy

A policy statement for technological update, whether local, state, or national, should have several qualities. First, it should be *clear* in its presentation of both goals and procedures. Although policy statements are by nature phrased in general terms, they should not be vague. Since the goals and procedures presented in statements of policy form the basis for future decisions and actions, the framework they outline must be lucid and comprehensible.

Second, policy statements should be *realistic*. Goals presented should be high but attainable. The level of currentness that teachers are expected to maintain should not be impossible; it is simply unfair to expect teachers to devote a full workweek to keeping up-to-date on top of their regular teaching duties. On the other hand, efforts toward teacher currentness should be reasonable; a two-day visit to local businesses or industries once a year is not likely to result in any real improvement in currentness.

Third, procedures outlined in policy should be *practical*. Paperwork and administrative approval for teacher activities should be reduced to a minimum; a variety of options for teacher activities should be allowed, to accommodate individual variations in taste and learning style. Procedures should also accurately reflect the specifics of the local situation. It is useless, for example, for a technological update policy to describe a sabbatical leave as one procedure whereby teachers can keep up-to-date when everyone involved knows full well that there hasn't been money to send anyone on sabbatical leave for the past five years. In fact, a formal policy that ignores the realities of the local situation invites the agents affected to ignore that policy.

Fourth, policy should be *compelling*, given the critical nature of teacher technological currentness at both secondary and postsecondary levels. A brief and dry statement rehashing tradi-

tional notions of teachers' personal responsibilities toward their profession might be dignified but is also inefficient in the present situation. In the current state of teacher technological currentness, policy should sound a clarion call to all of the agents involved in the process of technological update; it should state the seriousness of the situation and move those agents to fulfill their individual responsibilities in response to this situation.

Areas Affected

The areas most affected by the need for a policy for technological update are teacher certification and recertification and staff development. It is in these two areas that goals and procedures for the preparation and continuing development of inservice vocational teachers are presented. Thus, any specific program of technological update for teachers would need to be supported by appropriate policy formulated by agents for certification, recertification, and staff development.

Greater attention should be paid to the currentness of teachers' technological knowledge and skills in other policy areas as well. Recruitment, compensation, and retention of vocational teachers currently place great emphasis on the pedagogical preparation and development of teachers (National Research Council 1983). In the matter of compensation, for example, this emphasis is apparent at a glance. Most local educational agencies use pay scales by which teachers *automatically* receive a salary increase upon completion of a graduate degree or specific number of graduate credit hours; such degrees and credit hours are most likely to be in pedagogical areas; furthermore, there is no comparable automatic increase for teachers who put an equivalent amount of time and effort into updating their technological knowledge and skills.

This imbalance between the emphasis placed on pedagogical development and that placed on technological development is perhaps most crucial in policies affecting teacher recertification and professional development. Those teachers who have been teaching full-time and away from the workplace for several years are often those who are most out of date. Their efforts to become and remain up-to-date in their technology should be required, supported, and encouraged by recertification and professional development policies. All too often, however, such policies emphasize and reward pedagogical development at the expense of technological competence.

This imbalance between pedagogy and technology can appear in either the goals or the procedures of a policy statement. When the goal statements concerning pedagogical development take three or four times as many lines of type as those concerning technological development, the reader will naturally draw his or her own conclusions about the relative importance of each. The same argument applies to statements of procedures: when several procedures are cited for pedagogical development and only one or none for technological development, a clear message about the technological is implied. Or, for that matter, when procedures for pedagogical development require less time and effort than those for technological development, there is little likelihood that the technological will receive equal attention.

All this is not to say that teachers' continuing pedagogical development should be ignored or de-emphasized—far from it. Pedagogy and technology are equally important elements in vocational teaching. No teacher, however skilled or up-to-date in his or her technological area, can offer effective instruction without knowledge and skills in pedagogy. By the same token, however, it is incumbent on vocational educators to accord to teachers' technological expertise the *same* value accorded to pedagogy.

5. CHARACTERISTIC: RESOURCES

The next essential, generic characteristic of a strategy for technological update is that it must provide the resources necessary to do the job. It is appropriate to insert one warning at this point: for the purposes of this document, resources do not include those persons or situations that can serve as the sources of up-to-date technological knowledge and skills. Those sources of update (industry resource persons or sites, other teaching personnel, literature, and so on) are treated in a later section of this document covering delivery techniques.

Potential Resource Requirements

Given this definition, there are three resources that must be provided in a strategy for technological update: time, money, and access. Provision of each one plays a role in enabling secondary and postsecondary vocational teachers to remain abreast of the changing technology of their teaching areas.

Time

Whenever teachers participate in any activity to update their technological knowledge and skills, they need time to do so. In some cases, this time must be taken from their regular instructional duties. For example, an industry training workshop offered during regular business hours in the middle of the academic year would require attending teachers to be away from their class duties. A substitute teacher would be needed to assume the regular teachers' instructional duties. Or, a personnel exchange between education and industry would involve time expenditure by a teacher supervisor to advise and monitor the teaching of an industry person not trained as an educator.

In addition, teachers need time to incorporate the results of their update activities into their curriculum. Regardless of how this time is provided, it will be required to revise instructional plans, activities, and materials to cover the new, updated knowledge and skills that the teacher has acquired. Likewise, time will have to be spent by whoever is responsible for planning, carrying out, or monitoring each of the four steps in an overall process of technological update.

Money

Another resource required in the process of updating teachers is money. Some of the cost of time discussed above will be monetary—a substitute teacher will have to be paid for his/her time and services. Time spent by clerical support staff for update purposes needs to be paid for as well.

In addition, many of the update activities in which teachers engage cost money. In some cases these are direct instructional fees (e.g., tuition for university or college courses, workshop and

seminar fees). Other activities may involve indirect expenses that have to be borne. When teachers attend an out-of-town conference, there are travel and lodging costs, for example.

Finally, the monetary cost of technological update is not limited to the direct and indirect expenses of teachers' attending activities. There can be expenses associated with assessing teachers' needs, with incorporating the results of update into teachers' curricula, and so on.

Sources of Update

Finally, teachers, secondary or postsecondary, must have access to the sources of up-to-date knowledge and skills in their own technologies. Access should be equalized as much as possible for all teachers served in a given program for technological update. This has particular implications for two sources of technological update.

Business and industry. Business and industry are probably the most likely sources of up-to-date knowledge and skills for vocational teachers. Several of the delivery techniques commonly used to keep teachers up-to-date involve business and industry (i.e., work experience internships, industry observation and visits, staff exchange, and part-time employment) Consequently, the relationship between vocational education and local businesses and industries becomes very important.

The stronger and more positive this relationship is, the more likely ousiness and industry will be to cooperate with vocational educators in an effort to keep teachers up-to-date. When local business and industry personnel see and understand clearly the advantages to them of keeping teachers up-to-date, they will be more likely to devote some of their time and money to the task.

Work experience internships illustrate the point well. With this technique, used by both secondary and postsecondary institutions, teachers return on a temporary basis to a business or industry in their teaching technology and actually perform technical work. The length of time teachers spend on this activity may vary, but they don't return to industry to become permanent employees. If teachers are to derive any benefit from this experience, they need to occupy a legitimate position; they need training for that position and supervision in it as well.

The business or industry to which teachers return must bear some short-term costs in this process. Some supervisor's time must be spent training and supervising the teacher—time that must be taken away from the supervisor's other duties. Furthermore, the business or industry usually does not gain an immediate advantage from this supervisor spending time training and orienting the new employee. This new employee is going to leave fairly soon, so the business or industry never gets the benefit of the full production capacity of this trained worker.

In the long run, of course, the business or industry does gain from this expenditure in the sense that the updated teacher incorporates the new knowledge and skills into the curriculum and trains students who are better prepared for the reality of the workplace. When the relationship between vocational education is sincere and substantive, these long-term advantages are more likely to be seen and understood. Hence, vocational educators at all levels need to look to their relationships with business and industry to ensure that this source of technological update is accessible.

Programs of workshops, conferences, and seminars. Another technique much used to update teachers' knowledge and skills is formal workshops, conferences, or seminars. Often such pro-

grams are sponsored at the nonlocal level—a state department of education or a teacher education institution might offer such a program for secondary or postsecondary teachers throughout an entire state or region of a state.

In this kind of program, it is important to equalize access to events by offering them at convenient times and different locations. It would hardly motivate teachers in the extreme south of a state to attend events if they always had to drive two hundred miles to the same city in the north for a workshop. It would be unfair to expect these teachers always to bear the brunt of traveling this distance; the cost in time and money should be more evenly spread among all teachers served by the program. Workshops should be offered at different sites throughout the entire geographical area served by the program.

Provision of Resources

In our previous discussion of the roles and responsibilities of the agents involved in the process of technological update, the responsibility for providing these resources was assigned primarily to local boards of education and administrators and to state and federal department of education personnel. It is equally realistic, however, to expect teachers at both secondary and postsecondary levels themselves to provide a fair share of two of these resources—time and money.

It would be neither reasonable nor realistic for all technological update activities to be conducted on school time and at school expense. While teachers might justifiably expect some provision of released time from instructional duties in which they can participate in update activities, they can justifiably be expected to furnish some of their own time as well. And in fact, many teachers are ready and willing to use their own time for update activities.

Consequently, update programs or events offered during nonteaching hours can give teachers the opportunity to devote their own time to update. Events could be scheduled in late afternoon or evening, on the weekends, or during holiday or summer vacations. Each update program planner needs to be sensitive to the specifics of his/her own situation. If teachers in a given school, institution, or district feel overworked and time is critical, a better solution might be to provide released time as much as possible and minimize events that occur during nonteaching time.

The same logic applies to paying the direct and indirect costs of update activities. It is perfectly reasonable for teachers to receive some assistance with the expenses of update activities; it is also reasonable for them to bear some expenses themselves. All agents involved in the process of technological update have an obligation to their profession and all should share fairly and realistically in discharging that obligation.

6. CHARACTERISTIC: INCENTIVES AND REWARDS

Any effort toward a goal is most likely to succeed when the agents involved are motivated to act. This principle applies to the process of technological update; it applies most of all to teachers. Although administrators, planners, policy makers, and others might provide resources, support, methodology, and leadership, in the final analysis it is the secondary and postsecondary teachers who must participate in the various activities that are designed to keep them abreast of technological change.

Furthermore, teacher motivation is particularly important in the process of technological update. Lack of motivation was one of the barriers most frequently reported in previous work investigating the extent and level of need for technological update (Hamilton, Wonacott, and Simandjuntak 1982, p. 45).

Hence, teachers' motivation to participate in all phases of the process of technological update becomes crucial. For this reason, a further essential characteristic of a strategy for technological update is that it must provide incentives and rewards to achieve and maintain teachers' motivation to update their technological knowledge and skills.

Intrinsic Incentives and Rewards

Intrinsic motivation is probably the most effective motivation. It arises from values held by individuals and is based on their own backgrounds, training, and life experiences. Personal values can become powerful forces, impelling the individual to action in one way or another. Of course, when an individual's values are congruent with the values embodied in an institutional goal—a goal relating to technological update, for example—they can lend their motivating force to the individual's striving toward attaining the institutional goal.

A program for technological update can tap into teachers' intrinsic personal values. These values then become both incentives and rewards for participation in technological update activities in and of themselves. Properly managed, these intrinsic factors can help motivate teachers to keep up-to-date in their teaching technologies.

Professionalism

Most people, including secondary and postsecondary teachers, place a high value on performing well in their job. This means that most teachers place a high value on providing relevant, high-quality, effective instruction that will prepare their students for the reality of the world of work. This basic value, which we can call *professionalism*, naturally leads teachers to put time, money, and effort of their own into the job of teaching.

One part of this job, of course, is preparation. Many secondary teachers begin their profes-

sional life with four years at a teacher education institution, acquiring pedagogical and technological knowledge, skills, and certification. Others, especially at the postsecondary level, come to the teaching profession directly from industry and may spend the first few years of their teaching career carrying a double load—teaching a full-time schedule while at the same time receiving pedagogical instruction as an inservice activity.

Most teachers recognize that their professional preparation is not complete when they are first certified. They accept and work to fulfill their responsibility to continue this preparation by participating in inservice professional development activities. Consequently, most teachers are already intrinsically motivated to fulfill their responsibility to remain up-to-date in their technological area as a part of this ongoing professional development.

Tapping into this existing intrinsic motivation does require one preliminary, however: teachers must be aware of their own individual needs for updated knowledge and skills. It is not sufficient to know of and acknowledge a vague obligation to "stay up-to-date." Individual teachers need to know specifically that a new technological process is being used in the workplace, or that a new computerized inventory control system is now widespread, or that some technological advancement has occurred in their area. In other words, the individual teacher must be able to see exactly how his or her technological knowledge and skills are insufficient to operate in the reality of today's workplace.

Fortunately, a sound plan of action for the process of technological update automatically gives teachers the opportunity to become aware of their individual needs for updating. The first task in the updating process described earlier is to identify the need for updating. Consequently, if the process is based on reasonable and logical steps, the chance for this intrinsic incentive and reward to affect the process should be built in.

Accomplishment

Likewise, most people value the sense of accomplishment that they feel when they have done something positive, important, or worthwhile. An important part of this sense of accomplishment involves a sort of "cost/benefit" analysis of the thing that was done. If individuals have to put forth great amounts of time and effort to do something that is of little or no perceived benefit to them, there may well be no sense of accomplishment at all. Instead, there would be a sense of wasted time and effort, with no advantage gained.

This sense of accomplishment can also be harnessed to work for the purpose of technological update. Given the sense of professionalism that most secondary and postsecondary teachers feel, they will feel a sense of accomplishment when they have taken a step toward their own personal update goals. As they participate in and finish activities designed to give them up-to-date knowledge and skills, they will naturally consider that they have accomplished something—something that was of great and direct benefit to them, that did not require an inordinate amount of effort, and that helped to make them the better teacher that they want to be.

This sense of accomplishment does depend, of course, on the "cost/benefit" analysis referred to previously. The sense of accomplishment will be small (or nonexistent) if teachers sense that the activity just completed didn't help them, or if it required too much effort for the benefit received. In other words, if teachers have to sit through a workshop that is irrelevant to their own update needs, they will feel that they have accomplished little. Or, if they have to wade through a sea of red tape, engage in endless rounds of bureaucratic legerdemain, or spend hours in administrivia, they are likely to view the end result as not worth the effort it took.

The implications for a program of technological update are clear: the program must make it relatively easy for teachers to participate in update activities and those activities must be relevant. If these two conditions are met, then the program will derive the benefit of this strong intrinsic motivator among its teachers.

Extrinsic Incentives and Rewards

A program developed to update secondary or postsecondary teachers' technological knowledge and skills should also provide extrinsic incentives and rewards for participating teachers. Even teachers who have strong intrinsic motivation will derive benefits from adding the extrinsic. (Some teachers, of course, will not have high levels of intrinsic motivation to begin with.)

The types of extrinsic incentives and rewards used to motivate teachers toward high-quality professional performance are familiar to most educators. Salary, professional recognition, credentialing—these and other motivators are commonly used in vocational education. These motivators can be specifically linked to teachers' technological currentness and their efforts to maintain that currentness. Merit pay systems, for example, could easily incorporate pay increases for teachers' participation in technological update activities. Credentialing could be made to depend more on teachers' technological currentness. Undergraduate or graduate credit could be granted by teacher education institutions for teachers' occupational experience in industry. High teacher morale can be generated by professional recognition of outstanding performance. The provision of released time for participation in update activities can be a powerful motivator for teachers as well. Other motivators can be used to encourage teacher participation in the process of technological update as appropriate to the individual situation. Although motivation theory stresses the long-term advantages of positive motivation, the important consideration is not so much *how* teachers are motivated but that they *are* motivated.

All too often in the past, policy and practice have not motivated teachers to stay up-to-date with the technology of their fields. The critical nature of teachers' need for technological update is relatively new; therefore it is not widely reflected in the incentive and rewards systems used in vocational education. Staff development policies, for instance, are all too likely to describe a vague, general commitment to the concept of teachers' keeping abreast of their technologies yet fail to give teachers any real reason to act on this commitment.

The means for extrinsic motivation are at hand and already used to some effect in other areas of vocational education. It is essential that policy makers, program planners, and professional development leaders use these well-established means for the purpose of technological update.

Professional Development Credit Systems

One of the most common means of motivating personnel and promoting vocational teacher inservice activities is a system of professional development credits. In such a system, teachers are usually required to earn a certain number of credits in a specified time period; the time period is commonly one, two, or three years. The credit value of different kinds of activities is determined in advance (e.g., an eight-hour workshop might be worth one credit and college course work two credits per semester hour of college credit). Also, the total number of credits allowed for given kinds of activities is specified (e.g., teachers are required to earn twelve credits per year with no more than four of those credits coming from workshops). Such professional development credit systems are also used in other professions, of which two examples follow:

- As a requirement for relicensure, dentists in the state of Kentucky must earn ten points in continuing education activities annually. A schedule of approved continuing education activities is provided with the number of continuing education points assigned to each. Dentists record their activities and their point value on a form provided by the state board of dentistry for this purpose (see appendix B).

- The Ohio Dental Association sponsors a voluntary continuing education program for dentists in the state of Ohio. A certificate in continuing education is offered to all dentists in Ohio who complete 105 hours of dental continuing education activities within a period of three consecutive years. Two categories of activities ("Required" and "Elective") have been established for certification, with credit-hour values assigned to different kinds of activities in each category. A maximum of ten credit hours is allowed annually from the elective category; a minimum of twenty-five credit hours is required annually from the required category (although the entire annual total of thirty-five hours can come from required activities). A certificate of achievement is awarded to each dentist upon completion of each three-year program. (The approved listing of required and elective activities and their credit-hour values appears in appendix C.)

Restructured Graduate Programs

Another mechanism that would effectively motivate vocational teachers would be restructured graduate programs. Some vocational educators feel that this would be the most effective approach of all, since many states require that teachers obtain a master's degree or a specified number of graduate credits after a specified number of years in teaching. The master's program could be modified to include courses in technological content, which would provide the opportunity for teachers to acquire up-to-date knowledge and skills in their individual areas. This inclusion of technological content would help to achieve the more productive balance between pedagogy and technology described earlier as being desirable for secondary and postsecondary vocational teachers.

7. CHARACTERISTIC: HIGH-POTENTIAL TECHNIQUES

Instruction provided in a program of technological update can be accomplished through various delivery techniques. Those most appropriate for this type of program and most commonly used are work experience internships; university and college course work; workshops, conferences, and seminars; industry observation; education and industry staff exchange; and part-time employment. The examples below demonstrate one way in which each technique has been used for technological update:

- **Workshops, conferences, and seminars**—The College of Agriculture of The Ohio State University has offered a summer program, "Technical Update of Teachers of Vocational Agriculture," since 1980. Each year, the program consists of between fifty and sixty individual workshops. From 50 to 60 percent of the high school vocational agriculture teachers in the state register for the program each year.

- **University and college course work**—The Mequon-Thiensville School District in the city of Mequon and the village of Thiensville, Wisconsin, encourages vocational teachers to earn staff development credits by taking university and college course work. Instructors are required to earn four staff development credits every two years with at least one earned per year; teachers receive one credit for each semester credit of course work taken. Teachers are not reimbursed for tuition or other expenses involved.

- **Workshops, conferences, and seminars**—The College of Agriculture and Home Economics of The Ohio State University has offered a summer program, "Technical Update of Teachers of Vocational Agriculture," since 1980. Each year, the program consists of between fifty and sixty individual workshops. From 50 to 60 percent of the high school vocational agriculture teachers in the state register for the program each year.

- **Industry observation**—The state of Connecticut offers a program for school counselors, in conjunction with two universities in the state, in which counselors spend 120 hours during six weeks in the summer observing and participating in the activities of a host site in business and industry. Participating counselors receive a modest stipend from the state and are allowed some expenses during the period. Then, counselors take a seminar at one of the two universities, in which they plan and carry out a project for students in their school using the information they have gained in this exposure to the world of work.

- **Education and industry staff exchange**—Orangeburg-Calhoun Technical College in Orangeburg, South Carolina, operates a personnel exchange program with local industries. An instructor of the college takes the place of an industrial worker, actually performing the work of that person, while the industrial worker assumes the teaching duties of the instructor. Length of the exchange has varied from two to eight weeks. A total of five exchanges have taken place since the program began in 1979.

- **Part-time employment**—The state of Utah implemented a new program in the summer of 1982 for business and office education teachers, placing them in summer employment at business and industry sites. Although placed in their summer positions by a resource person at Utah Technical College as designated by the state Office of Education, teachers receive standard pay from host employers for their work and are supervised by regular employees of their host sites.

Although these techniques are those most likely to be chosen for use in a program for technological update, program planners must decide which to use and for which purposes. A fuller description and analysis of the characteristics, advantages, disadvantages, barriers, and facilitators of the techniques can be found in Wonacott and Hamilton (1983).

Criteria for Choosing Techniques

Techniques to be used in a predetermined program for technological update should be chosen according to a set of criteria. These criteria involve the adaptability, acceptability, effectiveness, and efficiency of the techniques under consideration.

Adaptability

First, the techniques to be used should be adaptable to a wide range of occupational technologies. This is especially important in programs planned and implemented at the nonlocal level (e.g., a state or regional program of update activities) or in programs offered by a single school, institution, or district and intended to serve teachers in all occupational areas. Part-time employment cannot be chosen as the sole technique for update when the employment market in one or more occupational areas is so tight that teachers are not able to find part-time jobs. By the same token, staff exchanges between business or industry and education will not be appropriate for teachers in program areas that have traditionally had poor working relationships with their local businesses and industries.

Likewise, techniques should be adaptable to a wide variety of administrative settings, again especially in programs serving teachers from diverse schools, institutions, or districts. A regional program serving a particular area of a state, for example, would probably include teachers from comprehensive high schools, area vocational/technical schools, career centers, skill centers, and possibly postsecondary institutions, both public and proprietary. Teachers from these various institutions would be acting according to the policies and practices of their various administrations and boards. Choice of techniques for a wide audience of teachers must take this into account.

Acceptability

A second important criterion is that a technique used for technological update must be acceptable to the actors involved. Work experience internships, in which teachers return to work in an actual practitioner's position in their technology, can serve as an example. While this might be an effective, efficient, and adaptable technique for update, it must be acceptable to the local businesses and industries; obviously, they must be willing to place teachers in practitioner positions. Furthermore, this must be acceptable to school administrators. Unless internships take place during summer months or evening hours, teachers may need released time and substitute teachers, both of which cost money. On the other hand, internships during summer months or evening

hours must be acceptable to teachers; if teachers are not willing and able to devote their own time to participating in this activity, the results will be disappointing.

Acceptability of a technique may vary from one service area to another. Part-time employment is a widespread practice in many trade and industrial programs, for example. It is quite uncommon in agricultural programs, however, because many teachers are employed on twelve-month contracts.

Effectiveness

Third, a technique used in a program for technological update must be effective—it must allow teachers to actually develop the specific knowledge or skills they need. Some of the common techniques for technological update (i.e., university and college course work; workshops, conferences, and seminars; and industry observation and visits) are most effective in delivering updated *knowledge* in teachers' technologies. Others (i.e., work experience internships, education and industry staff exchange, and part-time employment) are effective in updating not only knowledge but also *skills*. Choice of technique often rests in part on whether it is knowledge or skills that need to be updated.

On the other hand, the effectiveness of a given technique may vary. Skills *can* be effectively developed in college and university courses, depending on the quality of the facilities, faculty, and program. Workshops can also allow skill development if they provide equipment on which teachers can practice and reasonable time for practice.

Efficiency

Finally, a technological update technique should be efficient—it should require a *reasonable* commitment of resources and time per teacher updated. One example would be work experience internships. This technique can be very effective in delivering both knowledge and skills to teachers; however, it is not a very efficient technique for updating knowledge. Teachers need to be placed in practitioner positions in a business or industry, which requires business or industry cooperation. Time has to be provided for the activity—whether released time (and substitute teachers) or teachers' own evening or vacation time. All these resources have to be expended for a work experience internship when the same amount of up-to-date knowledge might be obtained in a single two-day workshop. On the other hand, internships may be very efficient when teachers need skill updating or knowledge *and* skill updating.

The same argument sometimes applies to the efficiency of university and college course work or workshops, conferences, and seminars in skill development. Either of these techniques can be efficient, depending on the nature of facilities, faculty, and program.

In considering the efficiency of a technique for technological update, it is important to remember that a "reasonable commitment of resources" is not limited only to resources at the disposal of the implementing school, institution, or district. As discussed previously, secondary and postsecondary teachers can also be expected to devote some of their own resources to technological update. It is not reasonable, however, to choose a technique because it saves the school or institution time and money and makes teachers provide their own. For example, part-time employment can be very economical from an administrator's point of view—teachers go out and find part-time jobs to work on their own time. The administrator doesn't have to provide released

time or pay substitute teachers or reimburse workshop fees; but teachers have to devote a good part of their own free time, which makes this technique less efficient from their point of view. A program that relies exclusively on part-time employment ordinarily will not be efficient (or well received, for that matter).

Applying Criteria to Local Situations

A generalized rating of the six delivery techniques discussed in this section according to individual criteria of adaptability, acceptability, effectiveness, and efficiency is presented in table 2. This set of generic ratings may not, however, apply to every local situation. For example, workshops, conferences, and seminars are rated as acceptable to the actors involved in the process of technological update. It is possible that the specific actors in any given local situation do not find workshops, conferences, and seminars acceptable in spite of the fact that most other people do.

This dislike of the technique could arise for numerous reasons. Perhaps workshops have been overused in a particular situation and teachers are simply tired of them. Perhaps a series of workshops given recently was of poor quality, leaving participants with a negative impression of workshops in general. For these or other reasons, the technique could be viewed negatively by local actors.

Other factors can change as well. Although workshops are generally not considered as effective in skill development as in knowledge development, this is not a hard-and-fast rule. Some industry-sponsored workshops come complete with actual equipment and machinery on which teachers are given the opportunity to develop hands-on skill as well as knowledge. And even though workshops are usually considered efficient because many teachers can attend and profit from them, this could be subject to local conditions as well. It can be very expensive to bring in a professional workshop team from a great distance to serve a small number of teachers.

All in all, those planning and implementing a program of technological updating would need to review techniques under consideration and verify that they meet applicable criteria in light of the local situation. The ratings presented in table 2 can be taken as a starting point, but the specifics of the local situation must always be considered in determining the potential of a given technique.

TABLE 2
DELIVERY TECHNIQUE RATINGS

	Work Experience Internships	University & College Course Work	Workshops, Conferences, & Seminars	Industry Observation & Visits	Education & Industry Staff Exchange	Part-Time Employment
The technique can be applied across a wide range of occupations	Yes	Yes	Yes	Yes	Yes	Yes
Use of the technique is widely accepted by key actors (i.e, business/industry/ labor, teachers, school administrators, teacher educators, state department personnel)	No	Yes	Yes	Yes	No	Possibly
The technique is effective in meeting teachers' needs for *knowledge* update	Yes	Yes	Yes	Yes	Yes	Yes
The technique is effective in meeting teachers' needs for *skill* update	Yes	Possibly	Possibly	No	Yes	Yes
The technique is efficient (i.e., requires a reasonable commitment of resources per teacher updated) in meeting teachers' needs for *knowledge* update	No	Yes	Yes	Yes	No	No
The technique is efficient (i.e., requires a reasonable commitment of resources per teacher updated) in meeting teachers' needs for *skill* update	Yes	Possibly	Possibly	No	Yes	Yes
The technique is adaptable to use in a wide variety of administrative settings	Yes	Yes	Yes	Yes	Yes	Yes

8. CHARACTERISTIC: ALTERNATIVE TECHNIQUE CONFIGURATIONS

No two teacher technological update settings will be the same. Some settings will be quite similar regarding the nature of the occupational programs conducted and the related needs for technological update on the parts of the vocational/technical teachers teaching in those programs. The settings in which teacher update needs to occur may be very dissimilar in terms of the types of opportunities that exist for implementing various update techniques and the resources required for doing so. These factors will necessarily influence the efficiency with which teachers can be updated. The number of teachers in need of updating is a major factor that must be reckoned with in decisions regarding the technique or techniques to be used in providing teacher update. The nature of the new technology, in terms of the amount of related new knowledge required contrasted with required skill development, must also be considered.

In selection of techniques for teacher updating it is well to note that four functions should be provided by the update program:

1. Vocational/technical teachers need to be made aware of the new technology.
2. Teachers need to gain the requisite knowledge associated with the new technology.
3. Teachers need to develop skill in performing the specific tasks of the occupation that incorporate the new technology.
4. Teachers need to revise curricula and develop instruction to incorporate the new technology into the training program.

In most instances the teacher will likely become aware of the new technology through contacts with advisory committee members; contacts with business, industry, or labor representatives in the course of carrying out the instructional program; or through readings of professional publications. Often, within occupational areas, portions of annual state teachers' conferences are devoted to increasing the awareness of teachers regarding new developments within the occupational area.

In planning for teacher technological updating some analysis of the new technology is necessary in order to make appropriate selection of specific update techniques. The choice of technique for providing the required new knowledge and skills to teachers should include several major considerations: (1) the amount of new information needed, (2) the complexity of the occupational tasks and the amount of skill practice needed to master and teach the new skills, (3) the numbers of teachers to be updated, and (4) the accessibility of the teachers to the sources of update (e.g., a college course).

Figure 1 presents a model of the sequential steps in the selection of alternative approaches to be employed in the update program. Table 3 describes the effectiveness of the six high-potential techniques for both knowledge and skill development. (The reader may wish to refer to table 3 through the discussion immediately following.)

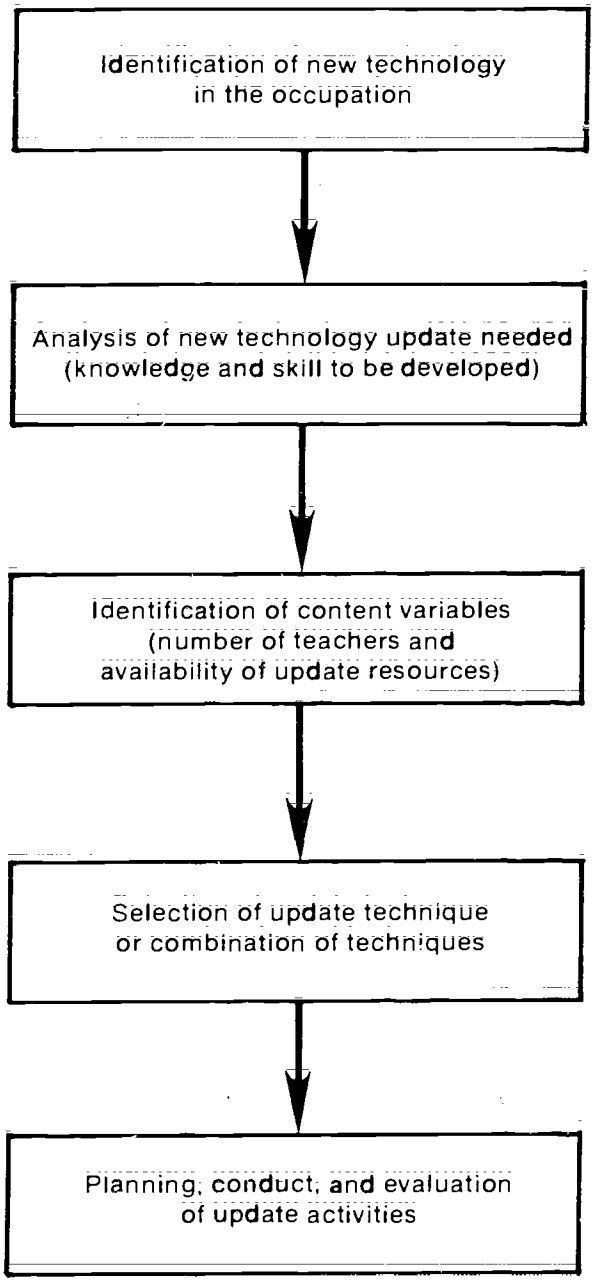

Figure 1. Model for selection of alternative technique configurations for teacher technological update.

TABLE 3

RELATIVE EFFECTIVENESS OF TEACHER TECHNOLOGICAL UPDATE TECHNIQUES IN DEVELOPMENT OF TEACHER KNOWLEDGE AND SKILL

Update Technique	Knowledge	New Skill
Industry Observation and visits	*some information, increased awareness	very limited and ineffective
Workshops, Conferences, and Seminars	**moderate amounts of information, depending upon length	*relatively simple skills not requiring extensive practice
University and College Course Work	****large amounts of information can be obtained	*some skill development can be included, depending upon nature of tasks and equipment availability
Part-time Employment	**some information can be obtained, depending upon resourcefulness of teacher	***substantial skill development if with state-of-the-art firm
Work Experience Internship	***substantial information if carefully planned and pursued	****extensive skill development if a planned sequence of experiences
Education/Industry Staff Exchange	***substantial information if carefully planned and pursued	****substantial skill development if with state-of-the-art firm

KEY: The asterisks rate effectiveness as follows:

* = marginal effectiveness
** = moderate effectiveness
*** = substantial effectiveness
**** = very high effectiveness

As an example of how an alternative teacher update technique might be appropriately used, consider the need for updating office occupations teachers within a state to teach microprocessor word processing. In examining the new technology, we find that basic information regarding document formatting is unchanged and basic keyboard skills are still required. New knowledge must be acquired, however, regarding the care and use of magnetic disks, display units and their manipulation, and the operation and care of the printer. Much of the learning of the functions of the word processor lends itself to hands-on learning with the presentation of new information and the immediate trial and application with a word processor. We determine that the presentation and practice of the basic functions of word processors can be accomplished in three days. Several different brands of word processors will be found in use among businesses in the state. They all have the basic component of the microprocessor with keyboards, display unit, and printer. It takes several days practice on a specific type of processor, however, in order to become proficient in its use.

Examination of the content variables reveals 120 teachers in need of updating to teach basic word processing skills. These teachers are distributed rather evenly through the state according to population concentration. A few secondary office occupations programs are now teaching word processing and several community colleges are offering word processing as a course. Of the new office occupations teachers trained within the state, approximately one-half are prepared to teach word processing. Office machine suppliers have indicated an interest in making word processing equipment available for short-term teacher training.

A series of six area workshops of three days duration is planned for the summer months. Workshops will be designed for twenty teachers each, with one word processor to be provided for each two teachers. Local schools and community colleges will be used as training sites. Word processors will be loaned by a supplier for the three days with a technician on call. Teaching materials will be introduced as a part of the workshop, as well as a series of practice exercises to be carried out by the teacher in developing skill in using the word processing equipment of their own school.

A fee reimbursement plan will then be provided to allow new teachers without word processing skills to enroll in a community college word processing night course or other word processing training available.

As another example, consider the community college that has determined that computer-aided drafting (CAD) needs to be added to the training program for drafters. There are three drafting instructors in the program, each of whom will need to teach students to operate a CAD system, execute drawing assignments, execute/change detailed drawings, and compose drawing.

To teach this new technology, the instructors will need considerable new knowledge, as well as extensive opportunities for hands-on experience in use of equipment and time for instructional development. Since there are no statewide or area plans for drafting teacher update in this area, it is up to the community college and these instructors to plan and arrange for their update.

A sequence of update activities is planned to update these instructors. First, arrangements are made for each of the instructors to participate in a one-week vendor-sponsored training program. A semester-long rotating work experience internship for the instructors is arranged with a major local employer of program graduates. One computer-aided drafter position is made available in order that each of the three instructors can fill the position every third week, with the other two instructors covering a reduced schedule of courses. The following semester, a portion of each instructor's work load is scheduled for instructional development, with instruction in computer-aided drafting initiated the third semester.

Consider, further, the example of the university vocational teacher education department that has traditionally cooperated closely with the state division of vocational education in meeting teacher inservice training needs. The state supervisory staff for agricultural education, in cooperation with the university department of agricultural education, has conducted the annual teacher needs assessment. Teachers report that many of their vocational agriculture students want to use their home microcomputers to keep and analyze their farm production records. Most vocational agriculture teachers, although trained to teach farm record keeping, have not been trained to use microcomputers to keep and analyze records. Newly certified teachers are now required to have completed the farm records course and basic computing course as part of their agricultural economics requirements.

Although thirty teachers have identified this need at the time, the widespread application of computers in production agriculture in record keeping and analysis and in management decision making indicates that this update should soon be accomplished by all two hundred production agriculture teachers in the state. In preliminary planning by the university departments of agricultural education and agricultural economics, it is determined that one full week of training in computer technology, including hands-on training with a sample set of user-friendly, computer-friendly farm records, would develop sufficient teacher skill and confidence to initiate instruction with their classes.

An initial one-week summer short-course is cooperatively developed and promoted with the teachers who have identified this need. Further, graduate credit is made available to those teachers who wish to meet application and fee requirements. A demonstration of microcomputer application in keeping and analyzing student project records is presented at the annual teacher conference and vocational agriculture teachers association meeting. The short-course is scheduled on a regional basis throughout the state for the following summer. Housing is provided by the state division of vocational education, instruction by the two university departments, and meals and travel expenses by the local school districts. The required agricultural economics course on basic computing is revised to include, as one project, the sample set of farm records to be kept and analyzed on home microcomputers.

9. CHARACTERISTIC: INCORPORATION OF UPDATE IN PROGRAMS

As previously discussed, the entire process of technological update becomes meaningless if the results of the process are not incorporated into the programs in which the teachers are teaching. Staying up-to-date in their technological areas is simply one of the means by which secondary and postsecondary teachers can attain the goal of providing relevant and effective instruction to prepare their students for the world of work. In this sense, technological currentness is not sufficient to guarantee that instruction is appropriate, but it is certainly necessary.

Program Areas Affected

The up-to-date knowledge and skills that teachers acquire in update activities should be reflected in three different areas of their programs. They should first be incorporated into the program curricula. This incorporation leads to a need for instructional activities and materials designed to present the new knowledge and skills. Finally, new tools, equipment, or machinery may need to be added to the vocational laboratory to allow teacher demonstration and student hands-on practice.

Program Curricula

New skills and prerequisite knowledge may need to be added to program curricula. The decision to include these does depend, of course, on the competency levels required by potential employers of program graduates. Teachers may acquire state-of-the-art knowledge and skills in their update activities that employers do not require of beginning employees; this reflects the frequent and justifiable desire of teachers to function at the "cutting edge" of their technologies. Indeed, it may even be appropriate to include information on such "cutting edge" developments in the program curricula, in spite of the fact that accompanying skill instruction for students is not included because employers do not require it.

In most cases, however, both secondary and postsecondary teachers will concentrate the efforts on acquiring knowledge and skills that will be required of their students in the workplace and should therefore be included in program curricula. Skill statements may need to be provisionally added to skill or competency profiles. Student performance objectives to cover both skills and prerequisite knowledge should be added to curricula as well. Whatever the form of the original curriculum and hence, additions to it, care should be exercised that inclusions appear in an appropriate sequence.

Additions to program curricula may also result in deletions. If new occupational skills and prerequisite knowledge render existing portions of curricula obsolete, such portions should be deleted from the revised curricula. In most cases, however, additions will supplement rather than replace existing knowledge and skills in program curricula.

Instructional Activities and Materials

Next, instructional activities and materials need to be developed to cover knowledge and skills added to program curricula. A logical sequence of information activities, practice activities, and feedback will be needed to enable students to attain each of the new performance objectives. Whether programs are operated using a conventional or competency-based approach, appropriate instructional plans should be developed for added objectives (e.g., lesson plans, learning activity packages, and so on). Finally, print and nonprint instructional materials will be required as specified in instructional plans.

The print and nonprint instructional materials needed for new student performance objectives can be acquired in two ways. Teachers can develop their own materials specifically suited for the content and activities that they have identified; many teachers prefer to develop their own instructional materials whenever possible. Or, materials may be obtained from other sources, including commercial publishers. Instructional materials are often available from the business and industry sources that provide update activities. Sometimes the instructional materials that teachers use themselves in update activities (e.g., workshop handouts, manufacturers' manuals, operation sheets, and so on) are appropriate for secondary or postsecondary student use in planned activities.

In fact, many technological update activities often include the opportunity for teachers to update their curricula and teaching materials as part of the activity itself. In a two-day workshop, for example, the last half of the second day might be devoted to planning and beginning work on instructional activities and materials for secondary or postsecondary student use. Furthermore, many programs of update activities require, as part of the program activities, that teachers identify changes in curricula and instructional materials resulting from updated knowledge and skills and furnish proof that they have made those changes.

Tools, Equipment, and Machinery

The inclusion of new technological skills in program curricula may require—or depend on—the availability of tools, equipment, and machinery. When employers want beginning workers to be skilled in operating a particular piece of equipment, students will need to have that equipment available to practice on.

Resources Required for Incorporation

The task of incorporating update results in secondary or postsecondary program curricula requires the same basic resources as the rest of the process—time, money, and administrative support. Identifying changes to be made in curricula, planning appropriate instructional activities, and developing instructional materials take time on the part of teachers and clerical support personnel. Acquiring commercially published instructional materials or new tools, equipment, and machinery will cost money. That much is obvious.

What may not be so obvious, however, is one possible source of cost-free instructional materials or equipment—local businesses and industries. Instructional materials, as mentioned previously, are often available from the providers of update activities or from product manufacturers; some update program planners, in fact, plan activities that include such instructional materials as much as possible. Program planners should also keep this possible source in mind as they set out to acquire equipment to meet new program needs.

Likewise, many businesses and industries are more than willing to donate tools, equipment, or machinery to vocational schools. Such equipment may be surplus to the firm's present needs; firms can usually get tax write-offs for a donation of this kind. Most important, however, is the long-range benefit that a firm would receive by donating tools, equipment, or machinery: with these items available, students would then be able to develop the specific technological skills that the firm would like its beginning employees to have. Vocational educators should always keep in mind these advantages to business and industry of donating equipment and should be ready to point out the advantages to local businesspersons who may not be aware of them themselves.

It will not always be possible, however, to obtain donated equipment from local businesses and industries. Consequently, vocational teachers and administrators will often need to plan for acquisition of equipment through regular institutional procedures. The need for the equipment must be justified and its cost included in the school's or institution's budget. The purchase of expensive equipment may be difficult in these days of tight educational budgets. It must be remembered, however, that the ultimate success of technological update progams depends on the incorporation of their results into program curricula—which often cannot happen without the acquisition of new equipment.

10. CHARACTERISTIC: CONTINUING AND SELF-RENEWING ACTIVITIES

The final essential characteristic of an effective strategy for technological update is that the process must be continuous and self-renewing. The continuing and self-sustaining nature of the update effort is what will bring teachers abreast of the technologies of their teaching areas now and keep them there in the future. The days of slow-paced change and casual attitudes and efforts toward maintaining technological currentness are no more.

Factors previously discussed in this document point to the need for continuing and self-renewing activities to keep teachers up-to-date. The rate at which technological change is occurring and the rate at which it is likely to occur in the future is greater than ever in our history; the faster change occurs in the technology of the workplace, the more likely it is that teachers are or will be out of step with that change, since they no longer participate in the day-to-day functioning of the workplace.

Furthermore, the more stable the population of vocational teachers becomes, the longer those teachers will, on the average, have been away from the day-to-day functioning of the workplace. As the average tenure of vocational teachers increases, so increases the likelihood that teachers do not possess the knowledge and skills characteristic of the state-of-the-art in their individual technologies. Hence, the need also increases for programs of activities designed to give teachers the specific knowledge and skills they need to prepare their students for the technologies they will encounter when they leave vocational programs and enter the world of work.

Finally, the very process of technological update leads implicitly to the continuous and self-renewing nature of efforts toward it. Any sensible approach to program implementation requires that the planning, execution, and results of the program be evaluated to determine its effectiveness and identify possible future improvements. Such an evaluation can serve only one purpose: to ensure that future programs benefit from the lessons learned in past efforts. This cycle of evaluation and implementation is based on the reality of the continuing *need* for program activities—in this case, technological update program activities.

11. IMPLEMENTING TECHNOLOGICAL UPDATE AT THE STATEWIDE LEVEL

State Leadership for Technological Update

Given the realities of vocational education in our society today, the most effective level at which to organize and implement a program for technological update is the state level. In each of the fifty states, an administrative superstructure already exists for the regulation, coordination, and promotion of vocational education. State-level agencies such as the state boards of education, state divisions of vocational education, and state teacher certification agencies have spheres of responsibility and sources of funding that are legally established; furthermore, such agencies generally exercise a leadership that is sanctioned by tradition. Thus, an effort to implement technological update programs at the statewide level will enjoy the benefit of established lines of authority and communication among all the agents involved.

In addition, implementation of technological update programs at the statewide level can maximize economy of scale. In a given state, there will likely be a large enough population of vocational teachers in all programs and occupational areas for cost-effective use of resources. An individual school or district might have only one or two agricultural mechanics teachers, for example, for whom that school or district would have to provide or arrange for relatively expensive individual activities. There would be a much larger number of agricultural mechanics teachers across the entire state, however; a program implemented for these teachers at the state level would be less expensive per teacher updated. On the other hand, the individual state is generally not so large that the numbers of teachers to be served or the distance required for travel become unmanageable.

Statewide implementation is also likely to have advantages in the funding of technological update programs. Individual schools, districts, and institutions most often simply do not have the funds available to finance comprehensive, effective programs to update their teachers. Tight budgets for local education agencies are a commonplace in today's economy. The state itself is often a more appropriate source of funding for such programs; in fact, state funding for professional development efforts is an established fact in education today. In addition, the state education agencies are best situated to act as a link with federal education agencies—interpreting guidelines, channeling federal funds into local efforts, and promoting state interest in the federal political arena.

It is vital, however, that implementation at the statewide level not destroy the *flexibility* of local schools, districts, and institutions to respond appropriately to their own particular needs. This flexibility, one of the advantages of the decentralized control of education in our nation, has traditionally allowed local educational agencies to be creative in adapting solutions developed elsewhere to the particulars of their own situation. Such creative flexibility is not possible if the components of a program for technological update are rigidly imposed. When components are rigid, furthermore, they are likely to become stagnant and even less responsive to actual needs.

It follows, therefore, that state-level agencies or personnel should avoid as much as possible the prescription of options to local update planners. They can best promote technological update

by assembling and disseminating information needed for update, by standardizing administrative arrangements to equalize efforts, and by allowing local personnel to choose and adapt options most suited to their own needs

Standard Administrative Arrangements

In a program for technological update implemented at the state level, it would be natural to standardize many of the administrative arrangements that will apply across all occupational areas. Such standardization can help ensure that all teachers receive essentially similar opportunities, benefits, and rewards even though they might be participating in essentially different activities. Of course, standardizing such arrangements also prevents the duplication of effort that would occur if each local education agency set out to make such arrangements itself.

College and university credit. State-level personnel would be the logical candidates to make cooperative arrangements with teacher education institutions for granting college or university credit to teachers for participating in technological update activities. Needed would be agreement on what kinds of activities are eligible for credit, tuition payment expected by teacher education institutions for granting credit to teachers, and a specific schedule of the number of credits to be awarded for specific levels of effort.

The schedule of credits to be awarded for levels of effort is a particularly important consideration in standardizing arrangements. It is essential that a uniform system of awarding credits be adopted across all occupational areas so that all teachers receive equal rewards for their participation in technological update activities. While a specific schedule of activities might be left up to teachers and administrators in the separate occupational areas, it would hardly be fair for teachers in one area to receive only one university credit for a particular level of effort while teachers in another area receive two for the same effort.

The specific effort required of teachers for credits awarded may vary. In some cases, simple attendance at an activity may result in the awarding of credits per unit of time; for example, a teacher education institution may allow teachers one graduate semester credit for forty hours of workshop attendance. In other cases, credit award may require more than simple attendance. An individual update activity, for instance, might consist of a twenty-hour workshop on a particular topic followed by individual projects in which teachers develop some kind of product for use in their program (e.g., student instructional materials involving the topic of the workshop). This entire activity (workshop attendance *and* developmental project) might be valued at one credit as well. Such credit values would need to be assigned to each kind of activity contemplated in a technological update program; the values assigned to different kinds of activity should be roughly comparable in the amount of time required for the activity.

Eligible update activities. Another administrative detail to standardize would be the kinds of update activities eligible for inclusion in the update program. Ideally of course, a program would include a wide variety of eligible activities suited to the varied needs of the teachers to be served and to the specifics of the state situation. If for some reason, however, a particular type of activity could not be implemented in a given state, the decision to exclude it from a planned program would need to be made for all occupational areas. Or on the other hand, a particular activity might well be appropriate in one occupational area but not in another because of differing practices and situations in the two occupations. To allow the activity for one area and disallow it for the other would require a decision at the highest level of responsibility.

Finally, some guidelines should be put in place for teacher participation in individual activities that are not part of the planned program. A single teacher or very small number of teacners may need update in a particular topic for which it would not be cost-effective to plan a group activity. In such a case, teachers would need to know how to go about planning and carrying out individual activities; standardized guidelines would be required for identifying appropriate activities, defraying the expenses of those activities, awarding possible college or university credit for them, and providing released time for participating teachers if necessary.

Funding and reimbursement for activities. Standardized arrangements should also be made for funding activities planned in the update program. Funding could be direct payment by the state education agency for the costs of the activity, reimbursement to teachers for costs, or some combination of the two. Funds available would need to be apportioned among the different occupational areas according to the numbers of teachers to be served (or some other realistic and equitable formula). If funds are allocated to local education agencies or to occupational area staff within the state education agencies, it may be desirable to set guidelines on the amounts that can be spent on different kinds of activities. In addition, guidelines would be needed for reimbursement to teachers for costs that they bear (e.g., travel and lodging allowances for teachers attending out-of-town activities).

Minimum standards. Finally, a comprehensive program to update the vocational teachers in a state might well include some minimum standards for teacher participation in update activities. Such standards would need to be formulated across all occupational areas; they could be phrased in terms of time spent participating in activities, individual projects following up on group activities, required participation in different kinds of activities, and so forth. Provision could also be made for further standards to be set up by pertinent agencies within each of the occupational areas, if appropriate.

Specific Occupational Arrangements

Just as certain arrangements logically apply across all occupational areas and should be standardized, others apply to the individual areas and are more appropriately made within each occupational area. This is not to say that different occupational areas will inevitably have different arrangements, of course. On the contrary, if two areas share similar details and a similar situation, they will likely have similar arrangements. The important consideration is that some of the arrangements for technological update programs should be suited specifically to the details and situation of the individual occupational areas so that program activities meet the needs of the teachers in the areas.

Needs identification. The process of identifying teachers' needs for technological update is one that would logically be best left to the individual occupational areas. Specialists within each occupational area would naturally be more aware of the specifics of the occupation—the content of program curriculum, the overall capabilities of teachers, the expectations potential employers have of program graduates, and labor market forecasts for the state. Consequently, it would likely be much more efficient to have the needs identification process managed and coordinated by such area specialists.

The means to identify teachers' needs would first need to be identified. Needs identification instruments or systems could perhaps be obtained from teacher education institutions in the state; these could be administered to individual teachers and the results aggregated by university or state division personnel in order to arrive at an overall picture of teacher needs throughout the

state. One important part of this overall picture, of course, would be statewide information on explorers' expectations of beginning workers, as those expectations constitute the level of currentness needed by teachers in the state.

Identification of sources and activities. Another logical task for occupational area specialists would be to identify appropriate activities to meet the identified needs of teachers and sources of expertise to tap in offering those activities. The specifics of different occupations, programs within those occupations, and the needs of the teachers involved may make one kind of activity inefficient or impossible to implement; or these factors may obviously point to another kinds of activity as being the most effective and efficient possible. Here again, occupational area specialists are most likely to have sufficient knowledge of the specifics of the area to make intelligent decisions.

Once appropriate kinds of activities are identified, sources of expertise (i.e., personnel and sites) must be identified for those activities. These sources will in many cases be located in business and industries in the state; equally, the individual departments of teacher education institutions within the state may offer faculty and facilities that can meet teachers' update needs. Once teacher needs have been identified and aggregated, program implementers will have enough information to make tentative approaches to possible sources of update activities regarding their participation in a planned schedule of activities.

Scheduling details Finally, occupational area specialists should be well equipped to determine many of the details of scheduling a program of update events for teachers. Decisions would be required on the location of update activities—should separate activities be arranged at different sites throughout the state, should resource persons travel throughout the state repeating the same activity at different sites, or should teachers travel to a centralized site to participate in a single activity? In many cases, the specific circumstances of the occupational area in the state will indicate one choice over another; if all the mining technology teachers are located in three adjacent counties, a single activity at a centralized site might well be the best answer.

Likewise, the timing of activities would require some informed decisions. It would be no use, for example, scheduling a three-day workshop for marketing and distributive education teachers during the same week that the national DECA convention is being held in Washington, D.C. On the other hand, such a workshop might very well be scheduled to follow or to coincide with a state convention (e.g., a seminar on computerized stock management systems to coincide with the state DECA convention). Here again, occupational area specialists would be most knowledgeable about the calendar of yearly events traditional in the area.

Organization at the State and Local Levels

Just as a clear definition of the roles and responsibilities of all agents involved in technological update is necessary, the responsibility for performing the tasks described in the previous section needs to be clearly assigned to different individuals if the effort toward update is to come to fruition. Responsible bodies should be constituted at both the state and local levels; specific tasks should be expected of each of those bodies. Ideally, the work of planning and implementing a total program for technological update should be shared by such state and local bodies working together.

Equally, responsibilities should be divided between *comprehensive* bodies to address different issues that go across all occupational areas and *area-specific* bodies that address issues of rele-

vance to a single service area of program within a service area. This division reflects that described in the preceding sections between standardized and area-specific arrangements; it depends again on the variations that often exist in the situations of the different service areas.

The organization presented in this section represents one possible definition of the responsibilities for leadership and action in a program for technological update. Other organizational configurations could be equally logical; others still could be more responsive to the situation of an individual state. It is important to bear in mind, therefore, that teacher needs for technological update in any given situation may be better served by assigning responsibilities to individuals in positions other than those specifically suggested in this discussion. The primary consideration in each case is that a given responsibility be assigned to an individual who is in a position to fulfill it.

State-Level Bodies

State comprehensive planning committee. An excellent approach would be to set a comprehensive committee responsible for planning at the state level. Such a committee could fulfill the responsibility for standardizing administrative arrangments described earlier in this discussion. It could also be empowered to perform such other tasks as are assigned to it by the state division of vocational education or the state board of vocational education. Such a state comprehensive planning committee would have the primary *administrative* responsibility for planning and implementing a program of technological update activities to meet the needs of teachers within the state; it would oversee, coordinate, and articulate the individual components of the program as they are planned and implemented to ensure that the overall program attains the essential strategic characteristics described previously in this document.

One logical candidate for the chair of this committee would be a state personnel development coordinator; most states list such an individual in the roster of their state division of vocational education. The individual in this position would have knowledge and expertise in inservice teacher activities, many of them similar or identical to the kinds of activities likely to be implemented in a program for teacher technological update. Furthermore, an individual in this position would have already a position of authority and established lines of communication with vocational educators throughout the state and with the customary providers of inservice activities. An assistant state director of vocational education would be another logical candidate to chair the state comprehensive planning committee.

Members of the state comprehensive planning committee should represent other agents involved in the process of technological update and other interested parties. The state advisory committee for vocational education should be represented by a member to ensure that the perspective of business and industry is heard. Each of the service areas should be represented by a member so that the different details of the various service areas' situations can be known and accommodated; the chairpersons of the state area-specific committees (described in the next section) would serve well in this capacity. A member representing the state certification agency could provide input on the effect of state certification policies on the update program. Vocational teachers should be represented by a member from the state vocational education association; this is especially important to avoid the appearance of the update program being imposed by administrators. Finally, a vocational teacher educator should represent the interests of teacher education institutions regarding college and university credit for inservice update activities.

State area-specific committees. A counterpart to the state comprehensive planning committee should be the state area-specific committees, responsible for planning and implementing those

details of the update program that are specific to the individual service areas or programs within service areas. In some instances, a single area-specific committee could attend to the details of an entire service area; for example, it might easily be feasible to have a single committee for the entire marketing and merchandising service area, given the general similarity among the individual programs within the area. In the trade and industrial area, for example, it might be more logical to have separate committees for automotive trades, metal trades, building trades, drafting, and so on, given the dissimilarity among the different program areas. The decision between a single committee or multiple committees for a given service area would depend on whether or not the different needs of the programs within the service area could be effectively and efficiently met by a single committee.

Members of the committees should represent the agents directly involved in the program for technological update. A logical chairperson for the area-specific committee would be the state supervisor for the service area. If multiple program committees are set up within a service area, they might be chaired by other state division personnel (e.g., an assistant supervisor or curriculum specialist in the area) or by a teacher educator or other professional development leader. Other committee members should represent the specific interest of teacher education institutions, teacher professional organizations, and state service area advisory committees.

Local Bodies

Planning committees at the local level would complement the efforts and responsibilities of the comprehensive and area-specific committees at the state level. They would be responsible for furnishing to the state-level committees the local information needed for planning and for implementing the decisions of the state committees at the local level.

Local comprehensive planning committee. The local comprehensive planning committee would be very similar in its composition to the state comprehensive planning committee. It would be desirable to have a local comprehensive planning committee for each secondary district or for each postsecondary institution or district. The chairperson of the comprehensive committee should, as at the state level, be an individual with a system-wide perspective (e.g., a professional development coordinator, director of curriculum, or director of vocational/technical education). Other likely members would be department heads representing each of the service areas, members of the local teachers' organization, individuals from the local vocational advisory council, and representatives of the local area-specific committees (described in the following section). Departments representing service areas could double as representatives of the area-specific committees if desired.

Local area-specific committees. Area-specific committees should also be set up to reflect the service or program areas of the local district or institution. As in the case of the state area-specific committees, a single committee might be responsible for an entire service area, or individual programs within a service area might be served by individual committees. This would depend again on whether or not the different needs of the programs within a service area can be effectively and efficiently met by a single committee.

Department or program heads would be natural candidates to chair the area-specific committees. Committee members should represent the local program or craft committees within the area. It may be appropriate to have members representing local teacher education institutions (or departments within those institutions)—for example, if a local teacher education institution traditionally provides inservice activities for teachers. Finally, there should be representatives of

teachers themselves and of local teacher organizations. It is important that such representatives be practicing teachers and *not* department heads or supervisors; teachers must perceive that they are consulted and that the work of such committees is not performed behind their backs and imposed "from on high."

12. POLICY RECOMMENDATIONS

We have seen the essential, generic characteristics of a strategy for technological update: an organized structure for action, defined roles and responsibilities, statements of policy support, provision of incentives and rewards, use of high-potential tactics, alternative configurations of tactics to meet local situations, incorporation of update in programs, and continuing and self-renewing activities. A successful program to update vocational teachers' technological knowledge and skills must meet these characteristics, within the limitations of the local situation.

We have seen, further, the critical need for successful programs for technological update. The seriousness of this need has been explained as a function of the rate of technological change in our society and changes in the teaching profession itself. It is likely that this need for technological update will continue to be critical; in fact, it may become more critical as technology continues to change at an ever-faster rate and as the average teacher tenure continues to increase. Hence, it becomes vital that vocational education leaders intervene to establish effective programs of technological update for secondary and postsecondary vocational teachers.

Given the nature and dimensions of the problem, this intervention should be massive and nationwide in scope. The resources of the individual school, institution, or district are unlikely to be sufficient to address a problem of this magnitude. A concerted effort needs to be made at all levels—local, state, and federal. Local participants in the process of technological update need to be guided by the exercise of leadership, the formulation of policy, and the provision of resources at the state and federal levels.

Specifically, the following recommendations will greatly increase the effectiveness of current efforts to provide vocational teachers with up-to-date knowledge and skills in the technological aspects of their teaching areas:

- Assessment of the need for technological update and plans to address this need should be a required part of local operational plans.
- Local operational plans should directly address curriculum update as a necessary part of teacher technological update.
- State operational plans should address the states' roles in planning and support of teacher technological update.
- State and federal departments of education should develop rules and regulations regarding administration of educational legislation to impact specifically on teacher technological update.
- Vocational teacher certification and recertification requirements should be modified to place greater emphasis upon the teachers' currency of demonstrated teaching competence and occupational competence.

- In order to attract and retain highly qualified vocational teachers, salary schedules should recognize years of occupational experience, including time spent in business/industry internships, as well as teaching experience and formal educational preparation.

- A federal program of update grants or fellowships to local districts or individual teachers allowing a variety of high-potential update techniques should be established.

- Tax incentives should be made available to businesses and industries to encourage their collaboration in providing quality occupational internships for teachers and for provision of equipment necessary for incorporating current occupational technology into vocational curricula.

- Occupational currentness should be a major criterion for selection of vocational teachers for "merit pay" or for designation as "master teachers."

- Vocational teachers should be paid to establish and coordinate collaborative arrangements with business/industry to provide work experience and instruction for vocational students in occupational areas in which the local school cannot provide up-to-date instruction due to teacher or equipment limitations.

- Staffing policies and practices in vocational education should be adopted, such as hiring of qualified part-time instructors and/or required, regular, paid business/industry internships for teachers, which will result in teachers more likely to remain current in their occupation.

APPENDIX A

MEMBERS OF THE PANEL OF EXPERTS

Gary Bunch, Training Manager, Whayne Supply Company, Louisville, Kentucky

Dr. James Collins, Director, National Council of States of Inservice Education, Syracuse University, Syracuse, New York

Dr. George Ferns, Professor, Department of Administration and Curriculum, Michigan State University, East Lansing, Michigan

Alan B. Lesure, Publisher, John Wiley & Sons, Publishers, New York, New York

Dr. Jack McElroy, Professor, Vocational Industrial Teacher Education, University of Kentucky, Lexington, Kentucky

Dr. Michael Parsons, Dean of Instruction, Hagerstown Junior College, Hagerstown, Maryland

Andrea Jones, Supervisor of Human Resource Development Owens/Corning Fiberglas Technical Center, Granville, Ohio

Dr. John Van Ast, Project Director, Iowa Curriculum Assistance System, College of Education, Iowa State University, Ames, Iowa

APPENDIX B

KENTUCKY CONTINUING EDUCATION CREDIT MATERIALS

CONTINUING EDUCATION CREDIT RECORD FOR 1982

KENTUCKY BOARD OF DENTISTRY
2106 Bardstown Road
Louisville, Kentucky 40205

KENTUCKY LICENSE NO. _____

Date	Course Title/Description	Sponsored by	Type of Meeting	Hours
1/82	Columbus Dental Society Meeting	Cols. Dent.	Local	
3/82	Columbus Dental Society Meeting	Cols. Dent.	Local	2
5/82	Columbus Dental Society Meeting	Cols. Dent.	Local	2
4/82	American Assoc. Of Endodontists	A.A.E.	Dent. Spec. Nat'l.	5
10/82	Ohio State Dental Meeting	O.D.A.	State	5

To the best of my knowledge, the foregoing record of my continuing education participation is true and accurate.

SIGNED: _____

NAME (PRINT): _____

OFFICE ADDRESS: _____

_____

_____

GUIDELINES AND SCHEDULE OF POINTS TO BE ACCUMULATED BY EACH LICENSED DENTIST FOR COMPLIANCE WITH THE CONTINUING EDUCATION REQUIREMENT FOR RELICENSURE:

Each licensed dentist requesting renewal of license must show evidence which is satisfactory to the Kentucky Board of Dentistry that he/she has accumulated ten (10) points of continuing education between January 1, 1982 and December 31, 1982. The evidence of ten points of continuing education shall be submitted on the CONTINUING EDUCATION CREDIT RECORD FOR 1981 to the Kentucky Board of Dentistry, 2106 Bardstown Road, Louisville, Kentucky 40205, NO LATER THAN DECEMBER 31, 1982.

The following schedule of points rating is adopted:

Local dental meetings . . . . . 2 points
State dental meetings . . . . . 5 points
Regional and national meetings . . . . . 5 points
(Regional meetings shall be defined as a meeting held within a specific region of the United States, not within a specific region of an individual state.)
Dental specialty meetings . . . . . 5 points
Study club dental meetings . . . . . 2 points
(Study clubs shall be defined as a meeting of no less than two (2) hours duration. They shall be chartered and adopt a constitution and by-laws, such constitution and by-laws to be filed with the Kentucky Board of Dentistry in order to be eligible to fulfill the continuing education requirement. One-half (½) of the meeting time shall be devoted to matters of professional interest.)
Continuing education in formally enrolled classes or clinics under sponsorship of a dental college or university, recognized dental association, or specialty license certifying board. . . . . 5 points per day
(Such courses shall be of six (6) hours or more in duration in order to qualify.)
Hospital staff meetings . . . . . 2 points
(Applicable only when a scientific session is held.)

The Board of Dentistry or the Secretary-Treasurer may, at its/his discretion, approve for continuing education credit such other courses as may be deemed worthy of fulfilling the requirement as related to continuing education.

KENTUCKY BOARD OF DENTISTRY

APPENDIX C

CATEGORIES OF VOLUNTARY CONTINUING EDUCATION IN OHIO

Required Educational Activities:
Twenty-five Hours per Year Minimum

R01. **Continuing education at a university**, recognized dental association, specialty group, or other accredited institution with the participant formally enrolled in classes or clinics. This is an unlimited category and all thirty-five (35) credits could be earned this way.

R02. **Local dental society meetings:**

a. One (1) credit per scientific meeting with maximum of ten (10) credits per year for attendance of society meetings.

b. Courses approved by the Accreditation Committee and sponsored by a society

R03. **State Dental Association Meetings:** Credit for attending specific scientific sessions. Maximum of three (3) credits per half day and six (6) credits per day.

R04. **Regional and National Meetings:** Credit for attending specific scientific sessions. Maximum of three (3) credits per half day and six (6) per day.

R05. **Dental Specialty or Recognized Academy Meetings:** Credits for attending specific scientific sessions. Maximum of three (3) credits per half day and six (6) per day.

R06. **Research Centers:** Didactic and Clinical. Authorization necessary from the Accreditation Committee.

R07. **Dental Seminar Meetings:** Credits for attending specific sessions. Maximum of three (3) credits per half day and six (6) credits per day. Authorization from the Accreditation Committee.

R08. **Teaching:** Faculty status of an approved dental, dental hygiene or medical school.

a A dentist engaged in teaching on the undergraduate, graduate or postgraduate level will be allowed a maximum of (20) credits per year.

b. Approved hospital residency program—fulltime director or instructor—twenty (20) credits per year.

c. Other institutions or organizations may submit application for accreditation to the Accreditation Committee and credits will be established.

R[illegible]. **Hospital Staff Scientific Sessions:** One (1) credit per hour up to fifteen (15) per year maximum.

R10. **Original Presentations:**

a. Presentation of a scientific paper, essay or course at one of the recognized dental meetings named in items R01-R08, ten (10) credits for each original presentation, two (2) credits for repeating a previously prepared presentation up to a maximum of ten (10) credits.

b. Preparation and presentation of an educational exhibit, clinic or table clinic at a recognized dental meeting named in items R01-R08, five (5) credits for initial presentation, two (2) credits for repeating a presentation up to a maximum of six (6) credits.

c. Publication of original scientific article in one of the officially recognized Ohio Dental Association or American Dental Association publications, twenty (20) credits. Publication of a book could earn up to fifty (50) credits, number to be determined by the Accreditation Committee. Credits may be obtained only for the initial publication.

d. Research that is in progress or completed, published or unpublished, can be submitted to the Accreditation Committee and credits will be awarded on the basis of the data submitted.

R11. **Internships, Residencies, or Graduate Programs:** Credit must be approved by the Accreditation Committee.

R12. **Study Clubs:** To qualify: A study club must elect officers, have by-laws, regular meetings and be registered with the Accreditation Committee. Credits for programs to be determined by the Accreditation Committee.

Elective Educational Activities:
Ten hours per year maximum.

E01. **Educational television** and radio programs, self-teaching machines, audio tapes, slide programs and other audiovisual educational activities.

E02. **Dental Correspondence Courses.**

E03. **Teaching Activities** not listed in Required Educational Activities.

E04. **Dental Programs**, meetings, courses, and activities not included in Required Educational Activities.

E05. **Other Activities** approved by the Accreditation Committee upon application to it.

REFERENCES

Hamilton, James B.; Wonacott, Michael E.; and Simandjuntak, Adonia. *Technological Update of Vocational/Technical Teachers: A Status Report*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

National Research Council, Commission on Behavioral and Social Sciences and Education, Committee on Vocational Education and Economic Development in Depressed Areas. *Education for Tomorrow's Jobs*. Edited by Susan W. Sherman. Washington, DC: National Academic Press, 1983.

Wonacott, Michael E., and Hamilton, James B. *Approaches to Technological Update of Vocational/Technical Teachers*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.