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ABSTRACT

A project entitled Model Programs for Rural Vocational Education was conducted in 1987-1988 to provide research and recommendations for the direction of rural education in Arizona. The model program for students in grades 7 through 12 that is described in this report is based on the research that was conducted during the project. The plan is based on the principle that it is no longer adequate to view vocational-technical education as an alternative to skill development in other areas. It thus revolves around a skill pyramid, according to which students proceed from mastering basic skills to mastering employability, occupational, and job-specific skills. The proposed curriculum is a developmental and sequential one that is designed to begin in the 7th and 8th grades (where the focus would be on basic and employability skills) and would continue through the high school years (where the focus would gradually evolve from employability skills through the more general occupational skills and eventually culminate in job- and employer-specific skills). The model outline presented in this report includes listing of the skills and specific courses to be taught at each grade level along with specific recommendations concerning appropriate school-industry relationships and guidelines for using the concept of magnet schools. References are included. (MN)

SECONDARY VOCATIONAL TRAINING IN TECHNOLOGICALLY INTENSIVE

INDUSTRIES IN ARIZONA: NEW DIRECTIONS IN RURAL EDUCATION

BY
GARY M. GROSSMAN, Ph.D.

FORWARD

A project titled Model Programs for Rural Vocational Education was conducted in 1987-88 to provide research and recommendations for the direction of Rural Education in Arizona. A subcontract of that project was completed by Dr. Gary M. Grossman of the National Center for Research in Vocational Education.

In this report Dr. Grossman has outlined a plan to be considered for improving the direction of rural vocational education in Arizona. This plan will become a part of the implementation of rural models being considered in upcoming regional meetings. The forum of these regional meetings will be to plan future directions for vocational education in Arizona.

SECONDARY VOCATIONAL TRAINING IN TECHNOLOGICALLY INTENSIVE

INDUSTRIES IN ARIZONA: NEW DIRECTIONS IN RURAL EDUCATION

INTRODUCTION

The purpose of this document is to define the conditions and establish a plan for the development of a new direction in rural vocational-technical education in Arizona. The plan is intended to be responsive to a number of key challenges to education in both Arizona and the nation, and to provide a model for the training of rural youth and their preparation for the workplace of the future. The broad outlines of the plan will be developed in this document, the specific implementation of which will depend upon the actions of the educational leadership of Arizona. However, the circumstances in Arizona are but a special case of the national imperative to respond to the needs of rural youth. This plan, therefore, must be considered in the context of issues facing rural youth in Arizona generally and their appropriate remediation.

Issues Impacting the Vocational Training of Rural Youth

Of perhaps greatest relevance to this project is the development of new technologies in the workplace and new approaches to work that are changing both the nature and content of employment in American society. With regard to this fact, much dialogue has been devoted to the rate of technological change and its effects upon the nation (Naisbitt, 1983; 1988; Ryan, 1988). Without question, the speed with which things change is of major consequence to workers. However, the greatest single impact technological change makes upon the workplace, as Adler (1983) and Grubb (1985) point out, is a transformation of the "quality" of requisite skills, not its supposed tendency to increase or decrease skill levels themselves. From the point of view of vocational-technical education, at issue is not only "adding" skills to a worker who already has an established set, but rather transforming a worker's orientation, or context, of work, what its meaning is, and what is perceived to be necessary to enhance career advancement and growth. Conversely, the existing systems of vocational-technical education must engage in a transformation as well. If the purpose of a curriculum is to train students for readiness in the workplace of the future, it would not be sufficient to simply add a course or even a curriculum to a traditional program without attention to other issues. "Abstract" rather than "concrete tasks and skills are emphasized by work in high-technology industries (Grubb, 1985). We can conclude, therefore, that an ability for the worker to deal with abstraction is crucial to the development of workers in these occupational groups. The worker of the future will be challenged not only by the need to learn identifiable and specific skills, but must also learn of a new and different approach to the workplace itself, emphasizing abstract and, by implication, transferable skills.

This need for transformation is obviously a challenge to those currently working who have skills which promise to be increasingly obsolete. Clearly, adult educators will play a major role in assisting workers to make this transition and much good work is being done in this area (see Sticht, 1987, Mikelucky, 1987). However, economic and social changes of the magnitude predicted will also make great demands on the extant systems of secondary level vocational-technical education. Youth will certainly be confronted by these social and economic developments and be forced to respond. Likewise, any entity proposing to provide adequate training to the workers of the future in technologically intensive areas will have to revise its approach dramatically or face obsolescence, in the same way that workers will. This imperative, on an institutional level, will create new opportunities for vocational-technical education in America. It may also, however, threaten its fundamental assumptions and will clearly demand new vision on the part of its leadership.

While the challenges to American youth and its institutions are serious enough when confronting the workplace of the future, they are even more apparent when discussing rural youth. Not only are sources of information about technology and systems of communication less available to rural youth than to their urban counterparts (Chapman and Infanger, 1978; Barker, 1987), but so is the diffusion of new forms of technology itself (Kenney, 1986).

The distribution of technological processes, their utilization, and their impact is not nearly so obvious to those outside of metropolitan areas. Rural youth do not, as a rule, interface with technology to the degree that urban youth do. Inevitably, this makes the need for "context" education much more critical, as are technologically relevant curricula in secondary schools which will enhance the competitiveness of the rural student in the labor market later in his or her career. Considerable attention, therefore, must be given to the issue of rural student awareness of the challenges of the future. Yet, a further issue for the leadership in vocational-technical education is rural residents are unlikely to "demand" such an approach or curriculum. To the degree that governing structures in education respond only to pressure, there is little reason to believe that a broad scale public outcry will soon occur over this issue in rural America. However, that this need tends not to be as clearly recognized in rural areas is the best evidence of its degree of severity. Thus, this paradox represents an opportunity for leaders in vocational-technical education to become more proactive and act as a vanguard for rural youth.

The challenges facing rural youth around the country are particularly underscored in Arizona. The state has unique social and demographic characteristics, a rich multi-lingual and multicultural mosaic prominent among them. These factors also serve to heighten and exacerbate many of the educational issues facing rural youth, particularly in geographically remote areas of the state. Disproportionate numbers of at-risk and LEP youth reside in rural Arizona, further highlighting the need for a progressive and proactive approach to vocational-technical education.

Equally, despite the data showing explosive growth in the urban centers of Phoenix and Tucson, most of Arizona is rural in character. Only two of Arizona's fifteen counties rank nationally as Standard Metropolitan Statistical Areas (SMSA) and over 95,000 of the state's 113,000 square miles are outside of those urban counties. Not only is the state geographically rural, but its rural nature is also reflected in the distribution of educational institutions. While approximately 75% of the state's population is urban (U.S. Department of Commerce, 1981), almost one-half of the state's high schools are in rural Arizona and enroll about one-third of the state's high school students (Arizona Department of Education, 1987). Arizona's schools, therefore, and to a lesser extent, its students, are disproportionately rural.

There are a many demographic explanations for these urban/rural differences. Irrespective of the reasons, however, rural students obviously require the same access to education as urban students insofar as they will need to participate in the same economic future. Yet, virtually all of Arizona's growth in business activities such as manufacturing, capital investment, and, of course, jobs occur in the two metropolitan areas (Lucking, et al, 1987). Thus, Phoenix and Tucson tend to provide students with far better access to skill development in new and emerging occupations, if only for the simple reason of their relative proximity to state-of-the-art technology.

Beyond access is a question of resources. Rural Arizona secondary schools, averaging less than 700 students enrolled, are typically in small communities lacking adequate tax bases to enable students to develop competitive skills in some areas, particularly those involving occupational areas highly concentrated in large cities.

That virtually all of the skills centers, magnet schools, and schools with comprehensive voc-ed curricula are in the urban areas is, therefore, by no means surprising and readily explainable. Nonetheless, rural students must be given an equal stake in the future of the Arizona economy, at least on the grounds than that industry will need these workers in order to grow and remain competitive in an increasingly international marketplace (Johnston, 1987). One would hope that an additional rationale for this program would be a concern for equity. A major purpose of this project, then, is to first establish a means of providing such equal access, recognizing that it will require a statewide commitment and substantial resources to ensure it. In addition, the previous discussion suggests that a transformation of vocational education curricula is in order to meet the challenges ahead, irrespective of whether the student is rural or urban. Experience shows, however, that schools in urban areas are necessarily better situated to address these issues. Therefore, a much more proactive approach in rural areas is again indicated.

Clearly, it is crucial that state leaders prepare to make a long-term commitment to the current and future needs of Arizona's rural youth, the absence of which will be both unproductive to the student and the Arizona economy and doom any discussion of curricular change as empty rhetoric. With a truly proactive stance, however, a transformation of such magnitude is not only possible but highly practical. With a serious investment, it can be done. Assuming this level of leadership commitment, a clear understanding of the conceptual bases of this new programmatic thrust is necessary.

Skill Development Model and Curricular Foundations

According to Lewis and Martin (1986), skill development can be conceptualized as a pyramid, each level logically based upon and a product of the one preceding it (see figure 1). Basic Skills are the foundation of the pyramid. They are what make the development of technologically relevant vocational training possible (Reich, 1988; Grubb, 1985). Traditionally, the development of these skills is the primary responsibility of general educators. At the top of the pyramid, on the other hand, are Job Specific skills, employers bearing most of the burden for training of this sort. Vocational educators, generally speaking, have taken responsibility for Employability and Occupational skills. While this analysis is not meant to be absolute in all respects, and while vocational education has always dealt with basic skills development to some degree as general educators have always included career and vocational modules in their instruction, these descriptions do serve to illustrate principal roles and functions as they have been traditionally regarded. They also represent what has been known as "tracks," alternative approaches to education, i.e., the academic/general, vocational, and "on-the-job" types of training.

Viewed in this way, the Lewis and Martin model also helps identify a major source of employer dissatisfaction with American education. Many employers feel forced to extend their reach far beyond the Job Specific Skill area, including skills of a most basic nature that many believe should have been addressed in schools (Vanis, 1988; Naisbitt, 1988). This is particularly the case in those industries utilizing advanced production technologies which have the greatest need of an appropriately

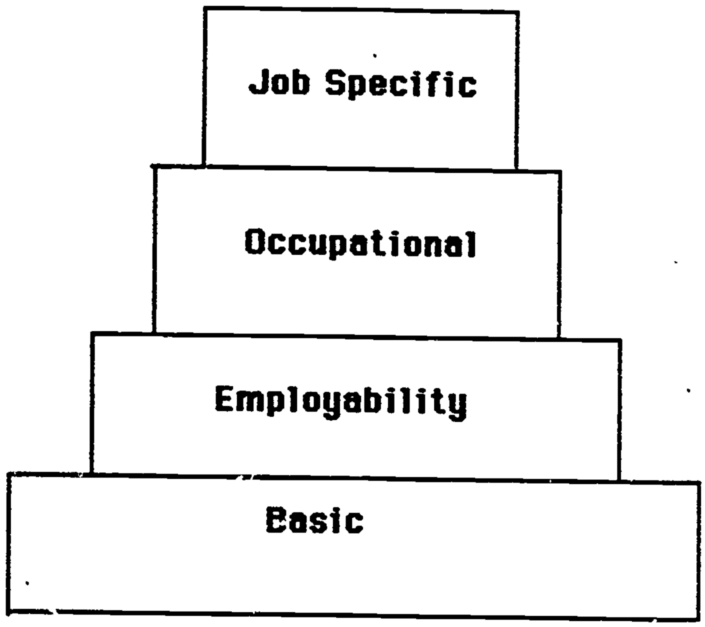


Figure 1. The Skill Pyramid

trained workforce (National Alliance of Business, 1987). Indeed, it is estimated that as many as 30% of America's larger employers find themselves forced to offer remedial education programs simply to remain competitive (Naisbitt, 1988). Tracking is often thought to be the source of the problems, i.e. the articulation of well institutionalized "turf", lacking necessary elements of skills integration. Continued failure on the part of American education to create this integration will cause even greater dissatisfaction on the part of employers. As technological change requires increasingly better equipped workers at the entry-level, American students become increasingly ill-equipped in these areas without high levels of both basic and vocational skills (Mikulecky, 1987; Johnston, 1987). An adequate curriculum is, therefore, one which emphasizes integration over articulation and incorporates technological change into its skill base.

In sum, the transformation in vocational-technical education called for by this approach is not exclusively within its traditional domain. Instead, in order to fulfill this mandate, a student must be able to approach the development of employment and occupational skills as a part to the overall educational experience. It is no longer adequate to continue to view vocational-technical education as alternative to skill development in other areas. Indeed, secondary curricula toward the development of employment and occupational skills for technologically intensive industries must speak in terms of the application of a strong background in basic skills, supported by sophisticated skill development in employability and occupational areas, finally being modified by the needs of a particular job and/or employer. A serious approach to training youth in technologically intensive jobs, therefore, must place considerable emphasis in basic skills areas as a major part of the foundation for sophisticated occupational instruction.

For the state of Arizona to embark upon this course will be a great undertaking, but the effort has great national importance as well. In so doing, the state is taking a position on and offering solutions to three major public policy disputes currently being debated in American education. First, it is making the statement that vocational-technical education is in fact not different than or in opposition to academic training. Secondly, it establishes that individual success in the labor market of the future will require elements of both academic and vocational education. Third, it accurately acknowledges the fact that the workplace challenge we currently face is not the result of educational failure. Indeed, recent evidence identifies an American population which is generally far more "literate" that in earlier times (Mikulecky, 1987). Instead, the new workplace calls for a new kind of worker some label "The Knowledge Worker" (Ryan, 1988). What happened is that changes in production technology have created new demands for increased worker skill levels faster than traditional systems have been capable of responding (Reich, 1988; Johnston, 1987). Arizona's intention, clearly, must include a new vision. Its pursuit will set a standard for the rest of the nation. This is the ultimate significance of the project in that nowhere else in America is an effort of such magnitude being attempted.

Correspondingly, as the need for a non-traditional program does not in itself constitute an indictment of traditional education, neither does a new thrust in vocational-technical education in Arizona suggest that traditional approaches to the workplace should be retired. Rather, a unique challenge to American society must be met be an equally unique programmatic response. That rural youth are at particular risk suggests a program targeted to these students. The program should, however, augment rather than replace existing systems of the delivery of vocational-technical education. Indeed, the basic skills requirements identified both explicitly in the literature and implicitly by the Lewis and Martin model suggest that this training in technologically intensive emerging occupations may not be appropriate for every student, rural or urban. However, the need in rural Arizona is such that students there must have access to this type of training in order to ensure equality of occupational opportunity and to provide Arizona industry with a competitive edge. These are, of course, important dimensions of the historic mission of vocational-technical education.

Upon making a commitment to an educational strategy of this nature, a review of curricula appropriate to respond to Arizona's educational challenge is in order. Secondly, an analysis of technology intensive industries which may be compatible both with the needs of students and the imperatives of the Arizona economy can be conducted. Third, the criteria for prospective locations of these programs around the state of Arizona will be recommended. Finally, potential resource bases for the program will be identified.

Preparation for Technologically Intensive Occupations: Middle and High School Curricula

It is proposed that training for technology intensive occupations begin at the middle school level (seventh and eighth grades) and continue through high school. The curriculum will be developmental and sequential along the lines of the Lewis and Martin model. Accordingly, courses at the middle school should focus on employability skills which assume a solid background on the part of the student in basic skills and involve a close relationship with his/her other courses. In general, high school courses will begin with employability skills, evolve through the more general occupational skills, and culminate with job and employer specific training. This program would be treated as independent of either the academic or vocational tracks as they are currently understood, and involve a merger of each. To reflect this difference, this new track might be called the "High Technology" or "Applied Technology" program of study. It would be selective and be competency-based, not only for admission but also for progress with the system.

Training at the Middle School

The Applied Technology track at the middle school level would emphasize the development of appropriate skills and attitudes in the workplace. While this curriculum will be discussed in the context of technologically intensive industries, it should be noted that these program is applicable to any type of career preparation and should be considered for statewide implementation, irrespective of a school district's participation in this program.

As indicated, the students will enter the program as a result of selection process. While no specific requirements will be established as entry-level criteria, certain measurable characteristics of the student should be considered involving basic, team development, and responsibility skills. While there are clearly other available criteria, some suggested considerations in each area are:

BASIC SKILLS

- o Is the student's performance in basic skills areas (reading, writing and computation) at or above the statewide median in nationally recognized standardized test scores at grade 6?

- o Has the student been progressing through grades 1-6 at a satisfactory level maintaining at least a "C" ("3" in Arizona schools) in basic skills courses? In all courses?

TEAM DEVELOPMENT SKILLS

- o Does the student work well with others and respect institutional rules as measured by a lack of disciplinary problems involving school or other authorities?

- o Does the student have a record of participation with others, such as participation in sports, extracurricular clubs, sharing hobbies with others, etc.?

RESPONSIBILITY SKILLS

- o Does the student complete school assignments in a timely fashion?

- o Is homework consistently completed in a responsible fashion?

- o Does the student show leadership ability in a demonstrable way?

Eligibility for the program, in short, requires a combination of either demonstrated or potential performance in basic skills, responsibility skills, and the ability to work as a member of a team (Ryan, 1988). Students who have these characteristics can be selected for this elective program prior to matriculation at the middle school, subject to their wish to do so. If school officials wish, they may include an interview to be conducted for establishing a student's wished in that regard.

Upon selection, the courses of the program will replace currently required vocational and/or home economics curricula. In addition, the English and math requirements should be modified to correspond to the program. Specifically, it is recommended that the school curriculum be organized in a mixture of standard and program specific offerings such that it supports the training. An example of an appropriate curriculum in grades 7 and 8 might be as follows (program specific courses in CAPS):

SEVENTH GRADE

First Semester

English
Math
Social Studies
Science
Health
Physical Education
CAREER EXPLORATION
COMPUTER I

Second Semester

English
Math
Social Studies
Science
Health
Physical Education
CAREER/RESPONSIBILITY SKILLS I
COMPUTER I

EIGHTH GRADE

First Semester

English
Math
Social Studies
Science
Health
Physical Education
CAREER/RESPONSIBILITY SKILLS II
COMPUTER III

Second Semester

Social Studies
Science
Health
Physical Education
ENGLISH (TECHNICAL SKILLS)
MATH (PRE-ALGEBRA)
BASIC PROGRAMMING
BASIC ELECTRONICS

The content in each of these areas contribute to the development of the program. Addressed individually, the requisite competencies emerge from the course content. It should be emphasized that instruction in these areas at the middle school level will only introduce the basic understanding of key concepts in these areas and attempt to provide a solid foundation for more intensive work at the secondary level.

o **CAREER EXPLORATION-** With the assistance of computerized career information delivery, the **CAREER EXPLORATION** module focuses on the relationship of between academic preparation and occupations, the various kinds of occupations and their job families, the differential requirements of occupations, etc. Special emphasis should be placed on jobs in technologically intensive industries, such as business and office technologies, health and biotechnology, microelectronics, telecommunications, advanced manufacturing, and robotics, and emerging computer technologies.

o **COMPUTER TRAINING-** Commencing with training in MS-DOS and other major interface systems, the student develops the ability to utilize basic word processing, spreadsheet, and graphics systems, such as WORDPERFECT, SAMNA, LOTUS 1-2-3, and SUPERCALC. As the students abilities in this area expand, the development of competency in simple programming in languages such as BASIC are introduced in the second semester of the eight grade. The student will have experience in developing and utilizing her/his own software programming in languages such as BASIC.

o **CAREER AND RESPONSIBILITY SKILLS-** This module will involve basic competencies in responsibilities as they effect job acquisition and retention. Introduction to job application procedures, the criteria for advancement and growth, and relevant attitudes toward work should be emphasized. In addition, life skills such as keeping a checkbook, paying bills, and co-worker responsibilities can be included. The bases of instruction in this format can be like much of the material currently presented in the JAG program. Team projects should be a central part of this module, including the introduction of the notion of the Quality Circle.

o **BASIC ELECTRONICS-** As a fundamental understanding of electronics is basic to virtually all new technologies, it is important that all students have some understanding of how electrical systems work. Emphasized in this module is how a circuit board is constructed and works, permitting some hands-on experience with modifying equipment such as typewriters, microcomputers, and other business related appliances.

o **ENGLISH AND MATH-** The English and Math courses in the final semester of the middle school experience will constitute the infusion of the principles of the standard program into the Applied Technology track. Examples of the type of activities indicated are writing essays on the word processor, performing mathematical operations on the spreadsheet, and applying competencies in math and English to problems constructed in the context of technical skills development. In terms of the program, second semester eight graders will obtain their instruction apart from their classmates during one segment of each school day, perhaps the afternoon. In this format, they would receive articulated instruction in

English and math, electronics, and computer programming as correlated parts of the same module. Care should be taken to ensure that students will have the opportunity to obtain the same elements of instruction as other students, the variation occurring in the context of the program. Team building and problem solving should be emphasized in this area.

At the conclusion of eight grade, standardized tests should be administered to the students such that individual progress and development in basic skills areas can be charted and compared to students not in the program. As well, these scores will provide the basis for criteria for admission into the high school dimension of the program.

Training in the Secondary School

It is anticipated that students who have successfully completed the middle school component of the program will have the required competencies for entry into the high school training. The qualification measures are essentially the same as they are in the middle school with respect to the basic skills, i.e. demonstrated performance on standardized tests at the statewide median or better among eighth graders, and should also include competency in computer skills and applications, electronics, and team development. Likewise, new students may be integrated into the program by demonstrating appropriate skill levels in these areas whether or not they have taken the middle school portion of the program. While this option would be available to the school at any time, it is clear that entry into the program at the beginning of each segment of the program would provide the easiest manner of assimilation of new students and maintain the team concept. It is, therefore, recommended that student access to the program be restricted in terms of entry to at least the beginning of the school year, and even then, students should be required to demonstrate the same level of technical competency as have their prospective classmates.

The high school dimension of the program will emphasize two distinct thrusts. First, roughly aligned with the 9th and 10th grades, will be a continuation of some of the instructional processes established in the middle school emphasizing strong basic skills development and employability skills training. In the latter part of high school, the student will be exposed increasingly to instruction pertinent to specific industries, and finally, to an analogue of on-the-job training with specific employers working in partnership with the schools. The driving force of the program at the high school level, therefore, will be the relationship between the school and the industry representatives, which is the key to the program's success. The nature of the recommended partnership will be detailed in a discussion of the final two years. The first two years are in many ways a continuation of the major themes found in the middle school program. However, unlike the middle school curriculum, the high school program will be specific to a particular industry and set of occupations, and thus, lack the generalizability to high school not participating in the exemplary program project.

The Program in Grades 9 and 10

Of central importance in the first two years of high school is the development of an occupational focus for the student as well as solidifying the informational and employability context established at the middle school. Therefore, transferability will continue to be emphasis, but its focus will progressively narrow such that the student will emerge through a process of course availability and student choice to entry-level employability in the industry with which the school is involved. As such, the first two years will necessarily be somewhat more rigid and less amenable to student electives in order to ensure the breadth of education required by Arizona law for the high school diploma, the general literacy demands of jobs in technologically intensive industries, and the specific skills required in current entry-level positions.

One feature of the exemplary high school program will be its emphasis on "higher-order" conceptual skills, the development of which is not necessarily required for graduation per se. An example of this would be student exposure to foreign languages, mathematics, and sciences beyond what students ordinarily must take in order to graduate. This requirement is partially explained by alluding to the need for transferability. However, the clear pattern of technological growth is not only expanded requirements of workers in terms of skills, but also the increased need for workers to be able to change an approach to a problem as the tools change. This requires thinking in context and should be nurtured through courses in which that kind of thinking is required (Johnston, 1987; Sticht, 1987). Accordingly, it becomes possible to genuinely equip a student not only for particular job out of high school, but also to extend the opportunity to adapt to changing circumstances on the job.

The recommended curriculum for the first two years is as follows:

NINTH GRADE

First Semester	Second Semester
English 1	English 2
Algebra 1	Algebra 2
Physical Education	Physical Education
Social Studies or Elective	Social Studies or Elective
FOREIGN LANGUAGE	FOREIGN LANGUAGE
BASIC SCIENCE	BASIC SCIENCE
COMPUTER PROGRAMMING	CAREER/OCCUPATIONAL EXPLORATION

EXTRA CURRICULAR ACTIVITY: JOB/OCCUPATIONAL CLUB MEMBERSHIP

TENTH GRADE

FIRST SEMESTER	SECOND SEMESTER
English 3	English 4
Geometry 1	Geometry 2
Social Studies	Social Studies
Biology	Biology
Elective	Elective
FOREIGN LANGUAGE	FOREIGN LANGUAGE

INTRODUCTION TO ADVANCED TECHNOLOGY (2 SEMESTER COURSE)

EXTRACURRICULAR ACTIVITY: Job/Occupational Club Membership

The program specific content and competencies to be gained by the student in the first two years of high school are:

c **FOREIGN LANGUAGE-** Competence and fluency in a foreign language is seen by many as being fundamental to the goal of being well-educated in a changing world. More central to the purposes of the program is the skill developed in thinking in an abstract context and developing one's language skills in terms beyond the terms one finds in every day life. While in the optimal situation, the languages a student could take would include those from societies involved in technologically intensive industrialization, e.g. German, Japanese, etc., practical considerations are such that this may not be feasible in rural schools which are involved in the program. Accordingly, it is entirely appropriate that the student be allowed to select this sequence from the courses offered in the standard curriculum of a secondary school.

o **BASIC SCIENCE-** The purpose of elective training in the sciences is to assist in the development of an empirically based scientific perspective and confrontation of problems in a logical manner. It is not anticipated that any particular courses are required by students in the program. Rather, it will be sufficient that some exposure to scientific methodology, the principles of science, and some degree of lab or field work be incorporated into the student's course of study.

o **COMPUTER PROGRAMMING-** This is intended to be a more advanced version of the middle school course. Familiarity with several programming languages should be developed and the student should be developed individualized software, concentrating on applications relevant to computer-assisted design and manufacturing.

o **CAREER/OCCUPATIONAL EXPLORATION-** With the utilization of a computerized career information system, the student should be given the capability to gain information about careers and about the occupational area for which the exemplary program in which her/his school is participating. In depth information about jobs and their requirements are indicated as is an emerging relationship with professionals in the respective fields.

o **INTRODUCTION TO ADVANCED TECHNOLOGY-** The intention of the course on Advanced Technology is to acquaint the student with the major trends in technological change with a particular emphasis in the industry in which the high school participates. The general design of the course is survey in nature and should involve some degree of interface with advanced equipment and production processes to the extent possible.

o **EXTRACURRICULAR ACTIVITY-** It is recommended that each of the schools participating in the programs across the state of Arizona coalesce into the formation of a job club similar to VICA or FFA in which students could achieve a sense of belonging and an outlet for their growing body of skills. This would also permit the involvement and influence of employers in a more formative manner than will occur later in the secondary school experience. Possible activities would include things like Computer Olympics, fairs, Career Days and other appropriate events.

The Program in Grades 11 and 12

Upon successful completion of the first two years of secondary schoo., it is critical to provide for student assessment for the final two years. As indicated, the curriculum will increasingly diverge form this point into much more specific types of occupational endeavors. Hence, it is of great importance that the student has been both successful in the program and is making at least satisfactory progress toward graduation. If this is not the case, the student should be counseled to either become involved in remedial programs, or preferable, be returned to normal track. For those students capable of continuing, the 11th and 12th grades will utilize all of the skills gained in the four years of the program and the foundation in basic skills achieved in other course work.

The central focus of the remainder of secondary training is the emphasis upon one industrial area which will define a range of content and relevant occupational groups in which the student can be trained. Insofar as the effort is to promote the marketability of the student after completion of high school, it is necessary for the student to be trained in terms of "state-of-the-art" work methodologies and information. This creates a dilemma, in that in traditional systems there is a "lag" between changes in the world of work and the ability of schools to present the information in vocational curricula. In addition, it is often the case, particularly in reference to technology intensive occupations for the cost of acquisition of the appropriate technologies to be prohibitive. For these reasons, the new vision recommended for the program must apply as much to the construction of the Applied Technology track as it does to the composition of the curriculum. As such, in order for the program to be effective, these issues need to be dealt with in a manner that is practical for the schools. It is necessary, therefore, that certain features of the program acknowledged prior to its introduction which will impact the selection of possible sites. It is useful, therefore, to evaluate criteria for school selection before specifying the 11th and 12th grade curricula.

To be considered by the educational leadership of Arizona are the following issues:

o **PARTICIPATION:** As the emphasis of the program is a focus on rural schools, the relative size of the institution needs to be considered. In typically small rural high school, it is unlikely that a sufficiently large cohort of the Juniors and Seniors will be interested in participating in the Applied Technology track. This is especially true given its rigor. It is therefore recommended that several school districts in a region participate in the program up to the 11th grade. For example, if the Springerville school system is the lead district in the program, it is possible that surrounding high schools, like Show Low, Blue Ridge, Alchesay, etc. can deliver the program through the Sophomore year. Springerville would serve as a magnet for the program in the later years of secondary school. Likewise, Globe and Miami High Schools could offer a joint program. Similarly, Safford could be the lead institution for the schools of Graham County. This would help to defray program cost by providing an economy of scale. It would also serve to train more rural youth in technologically intensive occupations. For the regional schools and their students, it would provide an exceptional foundation in vocational-technical education, whether or not the student chose to continue in the track.

Implementing the program in this respect would create several options, the determination of which could be done by the individual schools participating in a region or by a decision on a statewide level:

1. Students are transported to the magnet for only those aspects of the program in which it is necessary for them to receive instruction at the magnet:

Much of the instruction can be done via videotape technology or by satellite. As such it is conceivable, in certain industries, that attendance at the magnet be kept to a minimal level. Students could therefore remain in their home school most of the time, going to the magnet only occasionally.

2. Students are transported to the magnet for particular parts of each week, perhaps 2 days a week, on a regular basis:

For some industrial areas, intensive instruction on equipment may be necessary. In this case, arrangements could be made to provide transportation on a regular basis to allow students this opportunity. It may also require modification of the home schools instructional program in regular academic subjects required for graduation.

3. Students are instructed full-time at the magnet and are transported there daily, financial arrangements having been made between the participating schools:

If it is necessary, students can attend magnet schools for both the academic and vocational aspects of their instruction.

Clearly, there are difficulties with each option. As well, the type of training involved will dictate which alternative is least problematic. However, this analysis does serve to point out the crucial nature of school selection in terms of program substance. It cannot be an arbitrary process. The wedding of the site and the program is crucial to the success of the effort. It is therefore recommended that a series of important issues be addressed prior to the selection of any sites. While there are certainly other factors, the following should be prominent among them:

SITE SELECTION CRITERIA

o **GEOGRAPHY-** Is the prospective magnet isolated and remote from other high schools, such as Fredonia? Or is it within a short distance of other schools that could conceivably participate, such as Prescott, Globe, or Springerville?

o **EXPERIENCE/COMMITMENT TO VOCATIONAL EDUCATION-** Has the school demonstrated a commitment to vocational education in the past? Has it been willing to innovate? What has been its participation in non-mandated statewide programs in vocational education? What are its relationships to state leaders in education?

o **RESOURCE BASE-** Are the prospective site's resources such that it could and would cover incidental expenses of the program, such as transportation? Does it have or could it get appropriate secondary technology for program delivery, such as videotape equipment or satellite dishes?

o **WILLINGNESS TO BE EVALUATED-** The success of the program hinges on the ability to adequately assess and report results. Is it willing to conduct student assessments at the required intervals? Is it willing to allow for objective evaluation by outside parties to measure program success?

o **RELATIONSHIPS TO BUSINESS AND INDUSTRY-** Has the school shown efficacy in addressing the needs of business and industry, both locally and statewide? Do school leaders participate in the local JTPA efforts? Do they support the formation of job clubs on campus?

o **INFORMATION BASES-** Has the school shown an interest in providing up-to-date career, occupational, and labor market information in a systematic way to its students? Does it utilize these data in preparing its vocational education courses of study?

These questions will assist in the determination of qualified participants in the program. They will also serve to define what type of instruction can go to particular region. Those training programs, for example, which will require a great deal of hands-on instruction should be placed in a magnet school proximous to other participating schools. On the other hand, those institutions which are more remote must be provided with material requiring less interface with specific technologies.

RELATIONSHIP TO BUSINESS AND INDUSTRY

Another crucial aspect of the program is the relationship to business and industry. Indeed, it can be said without qualification that the only way in which technology intensive vocational training programs can work in the state of Arizona is with full support of the business community in general, most particularly those employers in high technology industries. As the desired "state-of-the-art" instruction can only be done in the context of its application, this application is being done only in the private sector. In addition, for students to be employable, even at the entry level, it will allow them a considerable competitive edge to be trained appropriate to the technological applications current among Arizona employers. Further, Arizona employers in these areas can and should become involved in the instruction, both in provision of materials and in the classroom presentation itself. Finally, insofar as Arizona employers in high technology industries will be provided the benefits of successful instruction in rural Arizona, they should also share some of the costs, particularly in providing the technology to the appropriate locations. It is therefore necessary that the Arizona educational leadership, such as the Division of Vocational Education of the Arizona Department of Education and the State Advisory Council for Vocational Education, serve as catalysts for this partnership prior to any implementation of the program. Put bluntly, it simply will not be effective unless Arizona industry is fully in support of the effort both rhetorically and substantively.

Beyond a genuine commitment to the program, it is recommended that Arizona employers participate not only in teaching (either in person or vie videotape/satellite), but also to serve in an advisory capacity at the school designated as the training site in its respective area. This should include both the chief executive officers of representative industries or their immediate subordinates and personnel in substantive capacities, such as production supervisors, engineers, etc. On a periodical basis, perhaps quarterly, these individuals should visit the sites and review the progress being made at the institution. This will provide for both the provision of substantive input and a solidification of the partnership that is necessary to drive the program.

Provided that magnet school sites are appropriately selected and a full commitment to the program is made by Arizona industry, it is appropriate to discuss the substantive areas amenable to instruction in a program concerning technologically intensive occupations.

HIGH TECHNOLOGY INDUSTRIAL AREAS FOR THE APPLIED TECHNOLOGY TRACK

Suggested for inclusion in the Applied Technology track are:

- o BIOTECHNOLOGY
- o MICROELECTRONICS TECHNOLOGY
- o TELECOMMUNICATIONS
- o BUSINESS AND OFFICE TECHNOLOGY

While these areas are by no means a comprehensive list of all possible high technology areas, it does provide a range of industrial areas which are emerging in the economy and are sufficiently diverse to suggest independent types of instructional curricula. They are, however, similar in the sense that they all share a similar requirement for the kind of basic and employability skills developed in the four years of the Applied Technology program. Additionally, while such topics as Computer Applications or Advanced Manufacturing could be introduced, these areas tend to be processes rather than substantive issues and are in many case subsumed within other foci. Indeed, considerable time has already been allotted to work with computers in the middle and secondary curricula. The recommendation, therefore, is to devote the 11th and 12th grade to content areas rather than work processes.

With regard to the respective curricula in each of these industries, a number of specific issues can be included in a course of study.

BIOTECHNOLOGY

Biotechnology, as defined by the U.S. Office of Technology Assessment (1984) involves the use of living organisms to modify plants or animals and develop microorganisms for specific purposes. It is one of tne fastest growing areas of technological expansion due to the fact that it is one of the least advanced at the present time (Cyert and Mowry, 1987). Therefore, it can be anticipated that it will also be among the fastest growing of high technology industries.

A unique feature of biological applications of technology is that they cover a number of occupational areas, including two areas in which have already gained considerable attention in Arizona's efforts in vocational education, agriculture and health occupations. Selected industries in biotechnology/health and biotechnology/agriculture and the intensity of their need for an interface with technology for instruction on-site are:

<u>Biotechnology/Health Industries</u>	<u>Intensity</u>
o Medicinal Production	MED
o Cosmetics	MED
o Surgical Appliances and Supplies	HI
o Surgical and Medical Instruments	HI
o Pharmaceuticals	MED
o Biologicals	LO
o X-Ray and Electromedical Equipment	HI
<u>Biotechnology Agriculture</u>	
o Food Technology	MED
o Agricultural chemicals	LO
o Animal and Plant Breeding	LO
o Enzymatic Processing	MED
o Fermentation (microbiological)	LO
o Genetic Engineering	MED
o Pesticide Production	LO

MICROELECTRONICS TECHNOLOGY

Microelectronics technologies are those which produce components on which information equipment and technologies rely (Cyert and Mowery, 1987). Included in this cluster are:

o Semiconductors and Integrated Circuits	HI
o Microprocessor Applications	HI
o Automation and Robotics	HI
o Electronic Computing Equipment	HI
o Digital Electronics	HI

TELECOMMUNICATIONS

Telecommunications technologies are involved in a number of production media, such as broadcasting, aviation, and communications. Among the types of industries that could be represented in the program are:

o Fiber Optics	HI
o Satellite Communications	MED
o Electronic Information/Communications Systems	MED
o Radio Television Transmission	MED

BUSINESS/OFFICE TECHNOLOGY

Business and office technologies concern those activities/processes which are performed in an office environment. They can include either application or production techniques. Among these industries are:

o Graphics Technology	MED/LO*
o Word Processing	MED/LO
0 Computer Software	MED/LO
o Office and Computing Machines	MED/LO

o Commercial Printing MED/LO

* Contingent on existing level of computer facilities

CURRICULUM STRUCTURE FOR THE 11TH AND 12TH GRADES

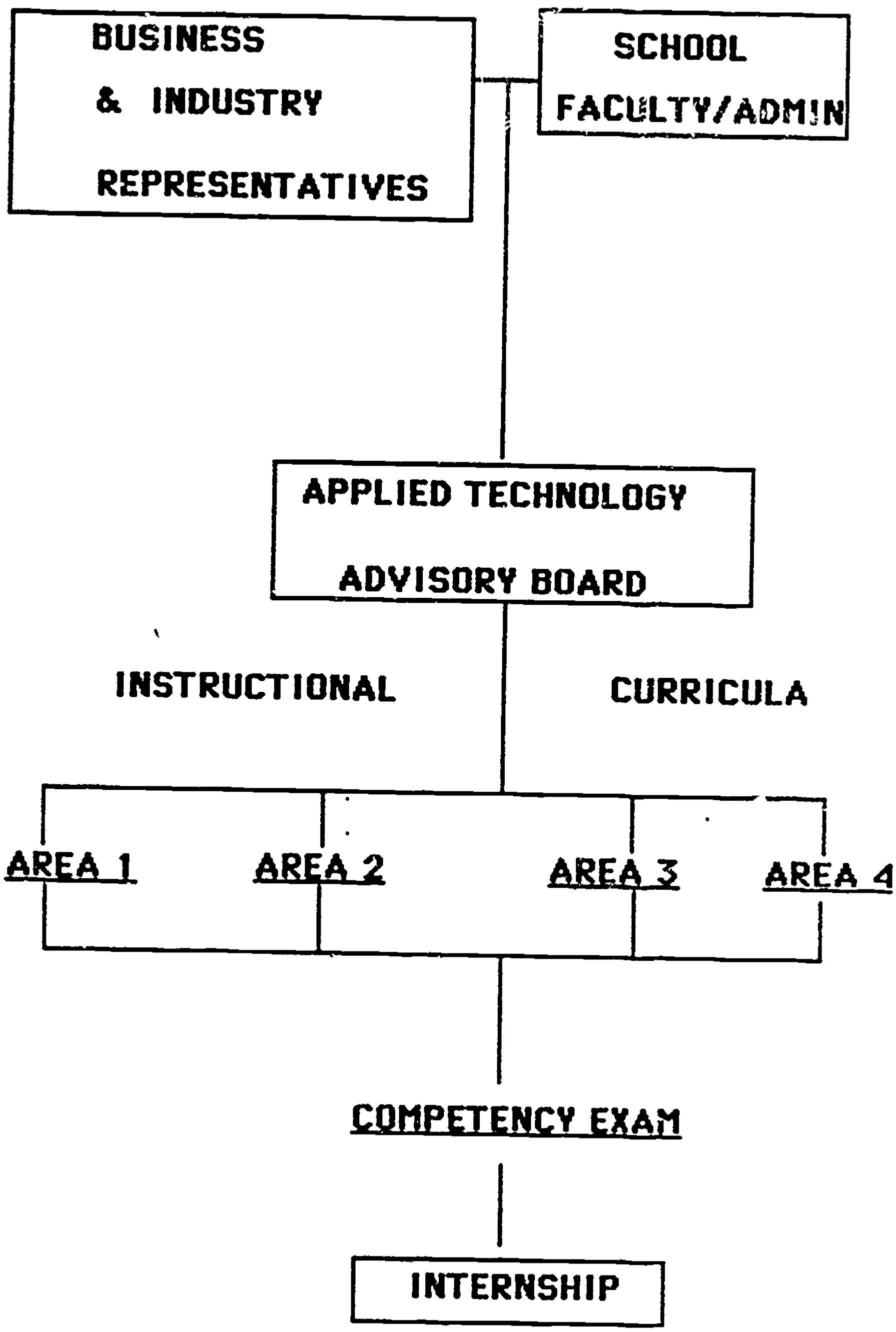
Curriculum development should, as previously discussed, take place in partnership with appropriate business and industry representatives. Assuming an effective relationship can be formed, the structure of the curriculum can be established.

Utilizing the Intensity factor and the criteria for site selection, a determination can be made as to the appropriate match of program and school. It is recommended that the initial effort constitute a placement of the four program areas in four separate locations. It is further suggested that the attempt be made to include as many industrial areas in each program as possible.

The implementation of this approach will depend on the ability to assemble a business-industry advisory board with sufficient range to offer a variety of courses. As an example, let us assume that Sierra Vista has been selected for the Telecommunications program. Insofar as virtually all of the major employers in these industries have either home offices or major representation in the Phoenix or Tucson areas, the advisory board can be made up of telephone companies, broadcasting firms, satellite dish manufacturers, etc. Representatives of these companies would work with faculty and administrators from Sierra Vista and several other schools to determine a curriculum. These representatives would also provide existing training materials, such as manuals and videotape equipment, and would also help the educators create additional ones. This could and perhaps should include satellite communications technology and uplink capability for interaction between the classroom and the employer. Training would then take place utilizing these facilities throughout the two school years. It is also strongly recommended that students be given the opportunity to do a six-week internship with the employer during the final period of the Senior year. While this would certainly be reserved for those functioning successfully during the program, it would also provide a unique educational experience that could be matched through classroom work. It would have to be clearly stated that employers would not be obligated to hire these students after graduation, this may well be a result of the program. If not, the experience itself would assist the student in finding and keeping similar employment.

Figure 2 graphically illustrates this approach.

FIGURE 2: CURRICULUM STRUCTURE IN THE 11TH AND 12TH GRADES



CURRICULUM IN THE 11TH AND 12TH GRADES

An appropriate course of study for the final two years of the program might be:

11TH GRADE

First Semester	Second Semester
English 5	English 6
Algebra 3	Algebra 4
Social Studies	Social Studies
Chemistry	Chemistry
Elective	Elective

OVERVIEW OF INDUSTRIAL AREA (2 COURSES/2 SEMESTERS)

12TH GRADE

First Semester	Second Semester/Internship
English 7	Business Communications
Mathematics	Business Statistics
Social Studies	Social Studies
Science/Technology Elective	Science/Technology Elective
Elective	CAREER EXPLORATION/ASSESS.

SPECIFIC INDUSTRY TRAINING (2 COURSES/2 SEMESTERS)

SUMMARY

This study has provided a comprehensive plan for training in technologically intensive industries. Beginning with the theoretical rationale, it builds upon the unique characteristics of Arizona to provide the foundation for vocational development such that students are highly marketable in some of Arizona's fastest growing industries upon graduation from high school. It also provides them a strong background for post-secondary training should that be desired. Above all, it will provide rural youth with a competitive edge in seeking employment and it may even allow them to surpass their urban counterparts. This would give a considerable boost to their life chances and provide the Arizona economy with a strengthened workforce.

As desirable as it could be, there are inevitable drawbacks. It will be relatively expensive, compared to "business-as-usual" training in vocational education. It will require teachers, administrators, school districts, state administrators, and business people. It will require a statewide entity, perhaps a university with extensive experience in vocational education and an understanding of rural Arizona, to provide management and evaluation services. Clearly, it will require a partnership among stakeholders on the Arizona scene to forge a genuine partnership, a cost and responsibility sharing, and a commitment to rural youth and the well-being of the state. Experience suggests that it cannot happen, if only because it has never happened anywhere, much less Arizona. However, that it has not yet become does not suggest that it could not be. With a serious commitment it can indeed occur.

Some may argue that it is too rigorous. It is that. While some modifications can certainly be made, course loads lightened, and programs narrowed, virtually all principles identified must remain intact to provide what is asked. Anything less would amount to a token effort, providing symbolic reassurance, but little else. It would be unfortunate if the leaders of Arizona opted for the latter. Vocational education has often so chosen, the results in many ways being visible in terms of unemployment, dislocation, and hopelessness.

Without question, the results will pay for themselves. It is only a matter of commitment to a brighter future for rural youth in Arizona.

REFERENCES

Adler, M. Paideia Problems and Possibilit s: A Consideration of Questions Raised By the Paideia Proposal (New York: MacMillan, 1983).

Arizona Department of Education. Annual Report of the Superintendent of Public Instruction 1986-1987 (Phoenix: Arizona Department of Education, 1987).

Barker, Bruce O. Interactive Distance Learning Technologies for Rural and Small Schools: A Resource Guide (Las Cruces, NM: ERIC Clearinghouse on Rural Education and Small School, 1987).

Chapman, Carol and Craig Infanger. " Taking Computers to Communities: New Developments in the South". Rural Development Research and Education. 2(1), 1978, pp.4-5.

Cyert, Richard M. and David C. Mowery (eds.). Technology and Employment: Innovation and Growth in the U.S. Economy (Washington, DC: National Academy Press, 1987).

Grubb, W. Norton. "Responding to the Constancy of Change: New Technologies and Future Demands on U.S. Education" in G. Burke and R.W. Rumbarger (eds.) The Future Impact of Technology on Work and Education (New York: Falmer, 1987).

Hodgkinson, Harold L. Arizona: The State and Its Educational System (Washington, DC: Institute for Educational Leadership, 1988).

Johnston, William B. Workforce 2000: Work and Workers for the 21st Century (Indianapolis: Hudson, 1987).

Kenney, Martin. Biotechnology: The University-Industrial Complex (New Haven, CN: Yale, 1986).

Lewis, Morgan V. and Scott Martin. Measures of Occupationally Specific and Nonoccupationally Specific Knowledge and Skills (Columbus, OH: The National Center for Research in Vocational Education, 1986).

Lucking, John, Ann Benjamin, and Dee Ann Everson. Arizona Statistical Review: 43rd Annual Edition (Phoenix: Valley National Bank, 1987).

Mikulecky, Larry. "The Status of Literacy in Our Society" in J. Readance and Scott Baldwin (eds.) Research in Literacy: Merging Perspectives (Rochester, NY: National Reading Conference, 1987).

Naisbitt, John. Megatrends. (New York: Warner, 1982).

Naisbitt, John. Trend Letter. June 21, 1988.

REFERENCES (con't)

National Alliance for Business. Employment Policies: Looking to the Year 2000 (Washington, DC: NAB, 1987).

Reich, Robert. Education and the Next Economy (Washington, DC: National Education Association, 1988).

Ryan, Ray D. Jr. "Impact on Technology: Evolving Directions on the International Scene". Paper Presented to the International Vocational Education and Training Association. Las Vegas, Nevada, December 7, 1987.

Sticht, Thomas G. Functional Context Education (Alexandria, VA: Applied Behavioral and Cognitive Sciences, Inc, 1987).

Swyt, Dennis A. The Technologies of the Third Era of the U.S. Workforce. A Report to the National Academy of Sciences Panel on Technology and Employment (Washington DC: Unpublished Manuscript, 1986).

U.S. Congress, Office of Technology Assessment. Commercial Biotechnology: An International Analysis (Washington, DC: U.S. Government Printing Office, 1984).

U.S. Department of Commerce, Bureau of the Census. 1980 Census Report (Washington, DC: U.S. Government Printing Office, 1981).