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A MINORITIES EDUCATIONAL PROGRAM FOR TECHNOLOGISTS IN A RESEARCH LABORATORY*

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Introduction

Many institutions including universities have recently sought to improve the opportunities for minority employment or student enrollment. Various forms of Affirmative Action programs have been developed, the most typical involving the formulation of employment policies which aim to favor minorities candidates in competitive job situations. At Stanford University, policies have been developed to encourage the enrollment of qualified minorities students; in addition, a special Master's Degree program for non-degreed but otherwise qualified minorities has been instituted and has been operating for about two years. This special program is in fact a Continuing Educational program for technologists who may or may not have formal technical training, but who in any case have achieved through work experience and practice a professional or para-professional level of competence.

The Stanford Linear Accelerator Center, a center for High Energy Physics Research supported by the Atomic Energy Commission, in 1969 initiated a special program dealing with yet another facet of the problem, namely the training of unskilled minorities personnel for jobs requiring the skills of degreed technologists. This program is unique in that it seeks to bridge the gap, often a chasm, between a severely impoverished educational background, and the white middle-class oriented entrance requirements of the average Junior College. Expressed another way, the typical student entering this program, were he left to face alone a degree program at a Junior College, would most likely fail to complete the program. The principal reasons for his failure would be the lack of guidance in strengthening weak educational backgrounds, especially mathematics; the lack of availability of meaningful counselling and tutoring; the fact that classes often proceed at an unrealistic pace, especially with colleges on

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a Quarter system which often cram a course designed for a semester into a single Quarter; and finally, because the college sometimes unwittingly places unnecessary bureaucratic obstacles in the path of a student such that he becomes confused, discouraged, or completely unable to cope with the system.

Although this paper does not describe a program of Continuing Education in the classical sense, some of the experiences and observations reported may be applicable to professional continuing educational programs where minorities or others with weak educational backgrounds are involved. In any case, the subject is of such importance that it should be of general interest to professional engineers and educators alike.

The following paragraphs describe the problems encountered both in developing the goals and implementing the program in a meaningful way in the Laboratory.

Historical Background

About four years ago, the Stanford Linear Accelerator Center (SLAC) inaugurated a training program aimed at bringing untrained disadvantaged employees into the work force at the technician level. While the program was aimed initially toward the ethnic minority groups at SLAC, the term "disadvantaged" was employed so as to include as wide a spectrum of employees as possible.

In its initial structure, the program was to be administered solely by the Personnel Department. There were to be twenty-five trainees spread throughout the SLAC work force, with the majority of trainees in electronics or mechcanical technology. Furthermore, SLAC undertook to train these employees, not for its own work force, but for potential jobs in the surrounding community.

The program was begun in the following way. Trainees were selected by the Personnel Department and apprenticed out to the various technical groups within SLAC. Each employee was expected to spend about one-third of his time attending classes leading to an Associate of Arts (AA) degree at one of the local community colleges with the rest of his time spent in on-the-job training at SLAC. At the end of a two-year period, the trainee was expected to be qualified to take one of the jobs advertised somewhere in the San Francisco Bay Area. His principal qualifications would consist of the technical portion of an AA program plus two to three a Quarter system which often cram a course designed for a semester into a single Quarter; and finally, because the college is sometimes guilty of placing so many unnecessary bureaucratic obstacles in the path of a student that he becomes confused, discouraged, or completely unable to effectively cope with the system.

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Unfortunately, the initial program met with little success. The depression in the job market occurred at about this time, drying up the source of available jobs even had there been successful graduates. In addition, there were problems within the program which were at least as serious as those in the outside world. There were some candidates in the program who had been selected not for their aptitude but on the basis of race and economic need. Occasionally, employees who were having difficulties in their working groups were placed in the training program in hopes of improving their ability to function in the Laboratory. All too soon, students began failing at class, and with no one to advise them and to monitor their progress, this led to considerable frustration. At the same time, when the trainees had been apprenticed out to the various technical groups within SLAC, there had been no concomitant training schedule established with the supervisors. Consequently, the training varied greatly from trainee to trainee, in most cases being inadequate. In addition, trainees were uneasy about outside job prospects even if they felt they could successfully complete this loosely-structured program.

The failures and frustrations of the program were evident to trainees and management alike. Subsequently, at meetings in which both participated, the program was reorganized along its present lines.

Program Development

Three major changes were made in the original program. First, students were to be trained for identifiable jobs within SLAC. Second, the school was moved to the SLAC site. Third, a position of Training Coordinator was established to monitor the technical aspects of the training program.

The concept of training technicians for the local business community simply could not work. SLAC was in no position to determine the necessary training while the students had even less of an idea of what was expected of them. However, within SLAC itself there was an identifiable annual turnover of electronics and mechanical technicians, and the qualifications for these positions were well delineated. Thus, students could be trained to fill one of a number of possible openings within SLAC itself.

In these two catagories (electronics and mechanical technician), there were about sixteen openings per year. Thus, if SLAC were to meet half of these needs with graduates of the training program, the program could sustain eight graduates per year. In a three-year long program, this would mean a total of twenty-four trainees at any given time, which was the original number assigned to the program.

The first attempt of the new program was to place trainees in those groups where an opening could be expected sometime within the next three year period. In doing this, trainees were once again spread throughout the different groups, making standardization of training difficult. Another factor, the depressed job market, altered the normal turnover pattern such that vacancies, when they occurred, never seemed to occur in the groups with a trainee. It was impossible to move trainees who had been receiving very specialized training into other groups where the qualifications were substantially different. These problems led to a further restructuring of the program.

Present Program Structure

A. Work Assignment

Trainees are given their on-the-job instruction in only two or three locations in the present program. They enter in a group (class) and learn together. Using the electronics program as the example, the first six months of instruction are given in the Electronics Assembly Shop where they learn basic electronic skills such as soldering, chassis layout and construction, recognizing components, etc. This is followed by a six to twelve month period in the Electronics Instrumentation Group where trainees work with Engineers and Engineering Associates learning devices, test equipment and circuits. Following this, they are given some specialized instruction from one of the many groups at SLAC. Through this schedule, they receive broad electronics experience such that they may step into one of the job openings at SLAC with a relatively small amount of additional training.

B. Academic Program

Contemporaneous with this change was the restructuring of the academic part of the training program. The concept of satisfying the technical requisites of the AA degree remains a valid one; it is a universally recognized and applied measure of the accomplishment of any training regimen. However, rather than sending trainees to the colleges where they often became lost in the academic maze, the classes were brought to SLAC. This turned out to be easier to accomplish than originally anticipated.

The Foothill-DeAnza Community College District already had curricula leading to an AA degree in the fields of electronics and mechanical technology (to mention only two). Within these degree programs, various specialization options are available to the student; these options are determined through dialogue with the immediate business community. For example, within the field of electronics technology, the student may choose among General, Solid State and Physics, Microwave, or Television options.

Both colleges, Foothill and DeAnza, have been extremely helpful in forming the concept of classroom training at SLAC. The contact at these colleges is through the Office of Continuing Education. Their requirements for classes being accredited are that the classes be academically the same as those at the local campus. This actually is an aid, in that it defines the classwork for the instructor. Classes are open to the public but the public has only occasionally availed itself of the opportunity. Instructors are on-site professional engineers and physicists who have been accredited by the State of California to teach at the Community College level. Certification usually is a straightforward matter for those with advanced degrees.

Bringing the classes to SLAC has solved many of the early problems of the training program. There is no longer a travel time loss for the student. The scheduled hours for the classes may be set according to the needs of the student at SLAC. There is a rapid feedback to both teacher and Training Coordinator such that any weaknesses are immediately known. Most important, the curriculum is under tight control and can be altered both in pace and in substance to better match the needs of the students and the Laboratory. Finally, there is a bonus in bringing classes on site in that they become available to other employees not in the training program. At least half of the students in these classes are not trainees but are full time working technicians, most with AA degrees or equivalent and a number of years of experience.

C. Training Coordinator

Concurrent with these other changes, a Training Coordinator was appointed to monitor the performance of the training program. While the duties were originally somewhat vague, there was the realization that a technical program needed to be monitored by someone with technical training. After almost two years, the duties have become more clearly defined and include the following:

1. Identify and include in the training curriculum the qualifications for electronics and mechanical technicians that are common to all the groups at SLAC
2. Locate good training locations and good supervisors
3. Set entrance criteria
4. Set achievement standards and make an estimate of the highest potential level of each trainee after he has been in the program for some time
5. Monitor the progress of each trainee. This means assigning each trainee a tutor, and apprising the tutor of the trainee's strengths and weaknesses. Each trainee is given a maximum of eleven hours a week for class time, including tutoring time
6. Coordinate the on-the-job instruction with classroom teaching

The incoming aptitude criteria and potential level determination are two important facets of this program. First, the program is aimed at producing electronics technicians at the ET-II entry level (ET-II is the "journeyman" technician level). In order to achieve this, each trainee must have between two and three years of practical experience as well as having completed the technical courses in the series (15 units of basic mathematics courses and 33 units of electronics courses. See Table I). However, not all trainees will be successful in the entire course. Thus the program will also produce highly skilled ET-I's (junior technicians).

We have discovered that the single most important entrance criteria necessary for successful completion of this training schedule is a sound knowledge of basic arithmetic - that is, manipulation of fractions and decimals. In order to meet the needs of those candidates with impoverished academic backgrounds a special course in basic arithmetic was set up at SLAC and is made available to all employees who want to attend. This course is given every six months. Surprisingly, this class is one of the most popular, with only a small fraction of attendees being potential trainees.

Discussion of Results

The Skills Training Program was established partly to increase the ratio of minorities in skilled positions at SLAC. Coincidentally, the program was to answer part of the hiring needs of the Laboratory by providing a pool of trained technicians. How has this program met these objectives?

Since the program has been in its present form only for the past eighteen months, it is still too early to judge the long-term results. Seven new trainees have been started in that time, and all are doing extremely well. The lowest class grade recorded has been a C; their job performances have ranged from good to outstanding. Of the earlier trainees, there have been mixed results though more than 80% of the trainees have been successful in the program at least to the ET-I level. Of the two who have failed outright, only one did so because of a lack of aptitude, and he has since left SLAC. There have been those who finished some but not all of the classes, yet who were judged by their supervisors and the Coordinator as being satisfactory electronics technicians for the ET-I classification. Of five in this category, two have finished the coursework on their own, and now are working at the ET-II level.

One of the basic aims of this program has been to produce technicians who have a solid base for progress to the highest levels of technical achievement, not just the lowest. The program certainly shows signs of being successful in this respect. Graduates who have completed all the courses are in general highly regarded by their groups. Of the successful graduates, one is now enrolled at Stanford University in the Special Master's Degree program mentioned earlier, while a second is preparing to follow.

One question often asked is, "How much time and effort are required to make such a program run?" The answer to this is that a very substantial commitment in terms of manpower and funding is an absolute necessity. The position of Technical Coordinator, originally envisioned as a half-time job, has taken almost full-time for the past year. Another professional has devoted many long hours organizing classes and securing instructors. Many meetings have taken place between the colleges and SLAC. At present, five classes are given each Quarter. Instructors of each class normally teach five hours a week. For each hour in class, there may be two or more hours spent in preparation. In addition, there are two Labs per Quarter, each with one instructor and one helper. Add to this a potential twenty-four tutors each of whom may spend an average of thirty minutes each day with his student, and the time expended becomes sizeable.

One benefit of the program which was difficult to predict in advance has proven to be substantial: With the successful graduates now in the labor force and with classes being given at SLAC, technicians already working at the II and III levels are returning to the educational path. Some have expressed a desire to "brush up"; others fear that their lack of fundamental knowledge may hinder them someday in the future when they are compared to the graduates of the training program. But most simply want what the trainee is striving for, namely the AA degree and the recognition and transferability of skills which it implies.

Summary

The training program was begun at SLAC about four years ago with great enthusiasum, a degree of naivete, and with ill-defined goals; yet for all that, it has managed to show a significant degree of success. By defining the goals, strengthening the controls over the program with the addition of a Technical Coordinator, and by bringing the classroom to the Laboratory, the program has become a proven success at introducing previously untrained minorities into jobs requiring a high degree of technical competence. A remedial arithmetic course has been added to the curriculum in order to make the program available to everyone including those with poor academic backgrounds. The program as presently structured is strong, and the graduates highly regarded by the various groups within SLAC.

As a final note, every program of this type must expect some success and some degree of failure. In attaining its short-term goals, this program is showing signs of being remarkably successful. The long-term results of the program can be judged only after it is seen how successfully these graduates will be able to advance to the higher levels of technical achievement and responsibility in our Laboratory, and how successful some may be in securing comparable or higher level jobs on the outside.

Acknowledgement

We are indebted to Foothill-DeAnza Junior College for their cooperation in implementing this off-campus program, in particular to R. W. Lee, Dean of the Evening College, R. Nelson, Chairman of the Engineering and Technology Division, and P. DeMarco, former Assistant Dean, now of West Valley Junior College. At SLAC we are indebted to G. F. Renner, Training Manager, and particularly to the many instructors, tutors and administrators whose voluntary efforts make this program possible.

ELECTRONICS CURRICULUM ≠

		Units
	Pre-Requisite	
Math 200*	Basic Arithmetic	
	First Year	
Math 101	Elementary Algebra	5
Math 50S	Intermediate Algebra I	2.5
Math 50T	Intermediate Algebra II	2.5
	Second Year	
ET51	Fundamentals of Electronics I Electronics Lab	7
Math 72	Electronic Mathematics	5
ET52	Fundamentals of Electronics II Electronics Lab	7
	Third Year	
ET53	Fundamentals of Electronics III Electronics Lab	7
ET54	Electronics Instruments Lab	7
ET58	Digital Electronics Lab	5
	Total Units	48

* Option, Given as a Remedial Course

≠ Course numbers refer to Foothill College designations

TABLE I

BIOGRAPHY - THEODORE M. JENKINS

After graduation from the University of California at Berkeley in Physics in 1955, Mr. Jenkins worked as a Health Physicist at the Lawrence Radiation Laboratory (now the Lawrence Berkeley Laboratory) for 3-1/2 years. In 1958, he left LBL to become Chief Engineer at an electronic materials production plant in Palo Alto, a post he held for 4 years before joining SLAC in 1962 as Deputy Head of the Health Physics Department. Since June of 1971, he has devoted part of his time to the Skills Training Program as its Technical Coordinator.

BIOGRAPHY - R. S. LARSEN

Raymond S. Larsen received his Bachelor's Degree in Applied Science, Electrical Engineering, from the University of British Columbia in 1956, a Master's Degree from the same Institution on a National Research Council of Canada Scholorship in 1958, and a Degree of Engineer in Electrical Engineering from Stanford University in 1966. He is currently Head of the Electronics Instrumentation Group at the Stanford Linear Accelerator Center, and a Deputy Head of the Experimental Facilities Department. Mr. Larsen has specialized in solid state circuits and systems, microwave and infra-red electronics, and more recently in nuclear electronics and associated data acquisition systems.

Mr. Larsen is active in the IEEE Nuclear Science Group, recently reorganized as the Nuclear and Plasma Sciences Society (NPSS). He is currently chairman of the San Francisco Chapter, and was recently elected vice-chairman of the NPSS (National) Administrative Committee. He also heads an NPSS sub-committee on Continuing Education and Professional Development; in this capacity he is responsible for developing Continuing Education programs for possible broad application within the NPSS membership.

At the Stanford Linear Accelerator Center Mr. Larsen is responsible for supervising instruction and curriculum for the Electronics portion of the Skills Training Program.