

railroad engineering into the undergraduate education program at Bucknell have been encouraging. It is felt that the future of the railroad industry is good and offers excellent opportunities for young college graduates. Bucknell plans to do as much as possible within limited fiscal constraints to continue the development of activities in the area of railroad education.

At this time, future plans are to increase Bucknell's involvement in sponsored research related to the railroad industry, to continue improvement and expansion of the current railroad engineering courses, and to extend the railroad offerings to the Department of Management.

Cooperative Training Programs for Undergraduate Students

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This paper describes the structure, operation, and accomplishments of a training program for undergraduate students undertaken cooperatively by the University of Hawaii and the Honolulu Department of Transportation Services with funding support from the Urban Mass Transportation Administration. The program consisted of a combination of activities that included practical student training, interactively conducted applied research, and a seminar series in public transportation. Recommendations are included that will, it is hoped, be useful to those contemplating similar efforts.

The derivation of mutual benefit from improved communication between universities and the transportation profession is a matter of increasing concern. The need for cooperation has been emphasized in relation to the utilization of the products of university research. In this case, the lack of involvement of the intended users throughout the research process has been identified as a critical barrier to technology transfer (1).

Recent conferences on engineering education have also recognized that the delivery of education and training programs stands to gain from a closer interaction between theory and practice. This is especially true in the case of undergraduate training in which the benefits of traditional university research are indirect and, according to a recurring theme advanced by employers, irrelevant to the demands of the entry-level positions sought by these students after graduation. University departments that emphasize undergraduate education are most sensitive to this need.

Efforts to increase the involvement of undergraduate students in the operational aspects of transportation and to enhance the interaction between the Civil Engineering Department of the University of Hawaii and the local professional community began in 1973 and led to the award by the Urban Mass Transportation Administration (UMTA) of an innovative research and training grant (provided by Section 11 of the Urban Mass Transportation Act of 1964, as amended) for the period beginning September 1, 1977, and ending August 30, 1978. Subsequently, a second grant was awarded for a study that was conducted from September 1, 1978, to June 30, 1980 (including a no-cost extension).

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Although smaller in scope, these programs were similar to the program grants that were initiated later by UMTA. These programs can be described as a hybrid between traditional agency-administered work-study undertakings and typical university-based research projects. They were undertaken in cooperation with the Honolulu Department of Transportation Services (DTS) and consisted of a combination of activities that included practical student training, interactively conducted applied research, and a seminar series in public transportation that was attended by students and faculty, practicing professionals from the public and private sectors, elected officials, members of citizens' advisory groups, and the general public.

The purpose of this paper is to describe the operation and accomplishments of these cooperative programs and to offer recommendations that will, it is hoped, be useful to those who contemplate similar efforts.

EARLY EFFORTS

During the academic year 1973-1974, the civil engineering students enrolled in the junior-level introductory transportation course were assigned the task of participating in a DTS project by taking passenger counts and conducting on-board surveys on two peak-period express-bus routes. Faculty members assisted in the design of the survey questionnaire and assumed the responsibility of scheduling and overseeing the collection and analysis of data (2). Virtually all the juniors in the civil engineering program that year were thus exposed to patronage surveys and the information that can be derived from such surveys. A similar project, concerned with a survey of what proportion of bus patronage consisted of fare-paying adults, students, the elderly, and the handicapped, was conducted in 1978 (3).

A major consequence of the original project was the part-time employment of six students in the spring of 1974. Their work consisted of collecting ridership data on the countywide bus system. In the meantime, efforts to establish more-formal cooperative programs resulted in the hiring of five student

interns in a program that lasted until June 1976. This program was administered by the Honolulu Civil Service Department under an existing public administration internship agreement between the city and county of Honolulu and the University of Hawaii. Funds were provided by DTS, and the university only monitored the academic performance of the students and had no formal input into the work program itself.

Similar efforts to place students as interns in local agencies were undertaken between the Department of Civil Engineering and the state of Hawaii Department of Transportation (HDOT). This resulted in the hiring of 16 students for one year beginning in September 1976. The interns were placed with various HDOT divisions and given subentry-level engineering assignments in the areas of planning, design, and construction under the supervision of HDOT personnel. This cooperative program is still in existence and involves approximately 20 students each year. The state program is both funded and administered by the cooperating agency and, as is the case with the city and county programs, university participation consists of maintaining and updating lists of eligible candidates.

This type of cooperative program is useful in the sense that it satisfies specific agency needs and provides some training for the students involved. However, individual student assignments are generally simple and brief and in many instances lack continuity and relevance to a well-rounded undergraduate academic program. The need has been recognized for an externally funded program that incorporates more-direct university involvement while it maintains the responsiveness of earlier efforts to agency needs. This has led to the award of the two UMTA-funded programs described in this paper.

UMTA-FUNDED PROGRAMS

The major thrust of these programs was the enhancement of the educational experience of undergraduate students by engaging them in a sustained training activity that paralleled the problem-solving process, beginning with problem identification and ending with the preparation of a final report.

The earlier cooperative efforts described above and subsequent discussions with the staff of DTS revealed the possibility of identifying a number of research areas that were complementary to the agency's activities but were not part of its work agenda because of manpower and other constraints. The undertaking of these research projects was considered to be desirable for both the agency, which could use the results of such projects, and the students, who could benefit from a more-realistic set of activities than mock academic exercises. However, it was understood that, unlike typical university research projects, the major emphasis was to be placed on training and that, when necessary, some project progress efficiency would be sacrificed for the sake of stressing the learning aspect of the endeavor.

A seminar series that featured guest lecturers from the local area as well as from the U.S. mainland was added to the proposed program. The purpose of the series was to complement the training component of the program and to provide an opportunity for the professional development of the agency's staff through the sharing of knowledge about contemporary developments in the field of transportation. The need for such technical interchange at the staff level is particularly felt in Hawaii because of its geographical isolation from the rest of the nation.

Program Operation

A committee of faculty principals and representatives from the various divisions of DTS was established to evaluate applications and interview and select trainees and to identify the general areas of concentration. At this stage, detailed project activities were left open, to be specified following a clearer assessment of the trainee's capabilities and educational needs as well as the availability of resources. The following criteria were applied to the selection of project areas: (a) satisfaction of short-term agency needs and (b) compatibility with the academic program.

The list of projects eventually undertaken includes the following:

1. Transportation of the elderly and the handicapped: Analysis of the profiles of eligible and actual users of Honolulu's Handi-Van system;
2. Transportation safety: An inventory of the agencies involved in the local safety program, the types of data collected, and the type of storage and retrieval methods employed;
3. Moped use: A description of legislative background, legal definitions, rules and regulations, and analysis of moped use to determine recreational purposes, user perceptions, and accident patterns;
4. Reactions to a bus transit mall in the central business district (CBD): Investigation of the reactions of the CBD daytime population toward a bus transit mall and that population's perceptions of the mall's impacts;
5. Bus-stop surveys: A series of surveys of bus users conducted at major bus-stop locations;
6. Demand-responsive scheduling: Literature review of existing algorithms and tabulation of their characteristics; and
7. Simulation of bus transit mall: Development of a simulation model to be used in the analysis of various operational and control strategies.

Student Training

A total of 14 students (mostly juniors and seniors) took part in the programs. Their participation was concurrent with a full academic load that absorbed approximately 20 h/week during the academic semesters and 40 h/week during the summer. Each student received a prescribed stipend. The typical trainee remained in the program for a full year.

The training program consisted of two inter-related phases. During the first phase, the trainees were assigned in pairs to the designated project areas, were provided space at the appropriate sections or divisions of the agency, and were given full access to the resources available there, including the agency staff. The degree of personalized attention given to the students by the agency staff in most instances exceeded prior expectations. This degree of commitment on the part of DTS, not only at the administrative level but also at the staff level, contributed greatly to the success of the program. The role of the faculty during the first phase was mainly as follows:

1. To maintain contact with the responsible DTS personnel in order to monitor the students' progress;
2. To aid in the design of student assignments;
3. To conduct a weekly plenary project meeting at the university at which students discussed their progress, exchanged information, and received instructions; and
4. To work closely with agency personnel in order

to define the precise nature and scope of the research projects.

The aims of this phase were to orient the students to the institutional and operational aspects of transportation planning by working closely within the planning agency; to familiarize the students with the contextual, historical, and policy character of their respective problems; and to provide the foundation on which to build later project activities. These aims were accomplished by concentrating on the following areas:

1. Problem area description;
2. Federal policy background;
3. Local response, including legislative actions, assignment of institutional responsibilities, and formulation of transportation strategies and implementation of specific actions (this effort exposed students to other agencies involved and resulted in the acquisition of an improved overall planning perspective); and
4. Investigation of local data sources (much relatively unused information was discovered, which strongly influenced the shaping of subsequent project activities).

In addition, the students helped the agency by performing on-going projects outside the scope of their project areas. For the most part, the students helped in the taking of surveys.

During the second phase, the day-to-day supervision of the students shifted to the university in accordance with the provisions of the program grant. The students' need for increased accessibility to the faculty and to other university resources (such as the Computer Center) caused their transfer to the campus. In addition to daily contact between students and faculty, plenary project meetings were held more frequently than before.

Interaction with DTS was maintained in two ways. The students continued to contact the DTS staff and that of other agencies when specific project needs arose, and the faculty met frequently with agency staff to report on the progress of the projects and to discuss modifications in the project tasks. Interim project findings were also transmitted to the agency for their immediate use.

The training emphasis was maintained by explicitly devoting time and other resources to the development of student skills in using research-related tools. For example, the trainees were encouraged to attend a series of short courses presented by the university's Computer Center on the use of available computer packages such as the Statistical Package for the Social Sciences.

In addition to the seminar series, the trainees were also encouraged to attend meetings of transportation-related organizations. As a result, two students were accepted as members of the Citizens' Advisory Committee of the Oahu Metropolitan Planning Organization.

Utilization of Results

The findings of the projects were immediately available to DTS and to other organizations. Project reports provided useful information that was incorporated into studies undertaken by agencies and their consultants. Requests for the reports were received from other universities and various planning and operating agencies throughout the nation and, to use traditional university criteria, papers based on the reports were presented at conferences and appeared in professional publications (4-6). The experience to date indicates that benefits from

the program will continue to accrue in the future.

Seminar Series

A major component of the programs was the presentation of a seminar series in public transportation. As originally envisioned, each seminar was to consist of a presentation on campus by a guest lecturer followed by a discussion period. However, when the first seminar was being arranged, it became clear that interest in the series was considerably more widespread than expected.

Agencies and other institutional entities expressed a desire not only to attend the seminars but also to meet the guest lecturers during their stay in Honolulu. Individuals, especially those from neighborhood boards and other citizens' advisory committees, also responded enthusiastically. Numerous suggestions for seminar topics and speakers and some proposals for cosponsorship were received.

In order to accommodate these interests, the seminar agenda was expanded from programs that contained a single presentation to half-day affairs that featured a mainland speaker whose presentation was complemented by those of persons from the local area. In addition to their presentations at the seminars, the mainland speakers met with various transportation-related groups to discuss issues of local importance. Some speakers agreed to participate in as many as three such meetings, which involved planners from public agencies, state legislators, city council members, and invited guests.

As far as the general community was concerned, the seminar series became the most visible component of the program. Audiences ranged from about 40 to as many as 250 and were drawn from the university and practically all transportation-related public agencies, decision-making institutions, professional and business organizations, and citizen groups. The presentations by 10 mainland speakers were complemented by 27 presentations by 18 speakers from the local area.

A brief description of each of the seminars in the series follows:

1. Transportation for the handicapped: Presentation of Denver's Handy-Ride system and local efforts by city and state agencies, including Honolulu's Handi-Van system;

2. Public transportation: Discussion of the range of transportation options available to urban areas;

3. Current trends and issues in public transportation: Contemporary concerns, which included political decision making, rail transit and urban development, transportation systems management, and ethics in decision making;

4. Planning for rapid transit: History of mass transit in Atlanta, Georgia, and the events that led to the formation of the Metropolitan Atlanta Rapid Transit Authority (MARTA); the role of transit authorities; financing; public referenda; and citizen participation [also featured were studies of the development potential around the stations included in proposals for a Honolulu Area Rapid Transit (HART) system];

5. Federal, state, and local government roles in urban transportation: Presentations by federal, state, and local officials that included the National Rail Transit Policy being circulated at that time;

6. Labor aspects of urban mass transportation: Policy and budget effects of labor negotiations on part-time drivers in Seattle and bus system operation through a management contract (i.e., the mode of operation of the Honolulu bus system); and

7. Integration and brokerage of urban transportation services: Description of options, organizational structures and financing arrangements, cost and service implications, labor relations, and case studies.

DISCUSSION

After reflection on the overall experience described above, two major areas should be considered when the establishment of cooperative training programs is contemplated--institutional considerations and the need for program flexibility.

Institutional Considerations

In fashioning the envisioned programs, it was necessary to consider the structure and orientation of the cooperating institutions explicitly. The fundamentally different objectives of the local agency, which is oriented toward its on-going projects, and the academic institution exerted opposing pressures during the formation of project activities.

Notwithstanding the personal commitment by individual staff members to the training of students, the institutional emphasis on the agency side was placed on tangible products. A tendency toward the use of students as in earlier arrangements became evident.

On the university side, individual faculty members enjoy relative freedom in selecting their academic activities. However, the level of effort required by the kind of program described in this paper is likely to be underestimated by some of the faculty and by university administrators. The former judge it lacking in comparison with traditional university research and the latter perceive it as requiring minimal university participation. These are understandable normative judgments that should be expected when the conduct of an unusual program is contemplated within an existing institutional framework. To use a trivial example, some difficulty was encountered in determining whether the programs should be placed under the administrative auspices of the university research program or under the auspices of the training units; the training unit was chosen.

In this connection, it should be stated that it is not the intent of this paper to argue that the programs it describes are intrinsically superior to other research and training arrangements. Rather, they are presented as legitimate options that address special needs and are quite capable of existence within the mixture of academic activities.

Flexibility

The program emphasis on training, the differing institutional perspectives, and an anticipated learning-curve behavior dictated the need for considerable program flexibility.

The selection of specific projects, for example, was highly dependent on the needs and capabilities of the participating students. To accommodate their diverse needs and to be responsive to changing agency needs, the program proposal specified a number of mutually defined areas of concentration but left the selection of specific projects open. However, a committee of faculty members and agency personnel was established for selecting trainees and project activities and for ensuring the continuity of the overall program. Generally, the projects selected were relatively small in scope and, most importantly, complementary to rather than competitive with projects on the agency's agenda that were undertaken either in house or through the use of consultants.

SUMMARY AND CONCLUSIONS

There exists a need and an opportunity to improve undergraduate education in public transportation by combining theory and practice through cooperative programs. The programs described in this paper emphasized practical student training, permitted the conduct of a series of small-scale projects that addressed the needs of a cooperative public agency, and presented a well-attended seminar series in public transportation. The UMTA-funded programs facilitated direct and continuous interaction between the University of Hawaii and the Honolulu DTS and permitted a considerable amount of flexibility in the selection of project activities in order to be responsive to the needs of the students, the participating agencies, and the university.

The programs consisted of two essentially independent components--a unified training-and-research element and a seminar series. Because of its overwhelmingly good reception by the professional and general communities, the seminar series was considerably expanded from its original design.

The training-and-research component placed primary emphasis on the training aspect but also produced immediately usable results. This was accomplished by directly involving the university and the agency in the entire process.

The programs succeeded in (a) enhancing the education of 14 students, (b) providing products of immediate use, (c) providing a forum for an open dialogue on public transportation issues that face the community, and (d) strengthening the ties between the university and the professional community.

The lessons learned from the experience include the following:

1. The programs showed that a seminar series and a unified training-and-research program that specifically involves undergraduate students are capable of meeting local needs not otherwise satisfied. However, it is not necessary that the two endeavors be part of a single program.

2. To be independently justifiable, a seminar series should address issues of wide community concern, and special efforts to attract a diverse audience should be made.

3. An explicit commitment to the training-and-research program should be sought from both the university and the agency. On the agency side, a commitment on the administrative level can impart a sense of program legitimacy to the staff.

4. Acceptance at the agency-staff level is crucial and should be established prior to the initiation of the program.

5. In order to enhance agency interest, the program should also be able to provide tangible products that are usable by the agency.

6. The fundamentally different institutional structures and objectives of local agencies and academic institutions should be expected to exert opposing pressures during the formation of program activities. The former tend toward the use of students for on-going agency projects that involve minimal university participation and the latter lean toward elaborate and relatively independent research endeavors.

7. A funding source such as UMTA's University Research and Training Program, which is external to both the university and the agency, can contribute to the establishment of an appropriate balance between the opposing tendencies mentioned above.

8. A certain degree of flexibility in the selection of program activities is also desirable.

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Overall Assessment of a Statewide Certificate Program in Transportation

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The Certificate Program in Transportation offered between 1977 and 1979 by the Consortium of the California State Universities and Colleges and the California Department of Transportation is described and analyzed. This program was intended for mid-level management employees and focused on the planning, design, operation, and management of public transportation systems. The program's curriculum design and mode of delivery are described; results of an evaluation based on perceptions of students, faculty, and administrators are reported; and lessons to be learned from the program's experiences are derived and discussed in terms of future efforts of a similar nature. Major conclusions include the following: (a) educational programs of this nature should be based on the sponsoring agency's specific organizational needs; (b) the course content and level of instruction should be based on the interests and capabilities of the students; (c) the mechanisms for delivery of courses should be as simple as possible; (d) specialized programs require specialized faculty, which may be a serious constraint; and (e) since innovative educational programs in transportation are apt to be expensive, organizations that wish to sponsor them should be willing to pay a premium price.

This paper describes and analyzes the Certificate Program in Transportation offered between 1977 and 1979 by the Consortium of the California State Universities and Colleges (CSUC) under a contract with the California Department of Transportation (Caltrans). Although its official statement of purpose was quite broad, the actual focus of the program was on public transportation. Its primary purpose was to assist Caltrans in its transition from a basically highway-oriented organization to a broad-based multimodal agency; it was to do this by broadening the perspectives of the Caltrans mid-level management employees by increasing their awareness of some of the issues involved in the planning, design, operation, and management of public transportation systems.

Although developed in cooperation with Caltrans and intended mainly for Caltrans personnel, the program was open to professionals from other agencies. Indeed, their participation was particularly desired since it was felt that Caltrans students would profit from exposure to the views of other transportation professionals.

The program consisted of a cycle of five three-unit courses to be offered over five 10-week sessions. The course descriptions, condensed from those in the consortium's 1978-1980 catalog, are presented below:

COURSE TS-400. Transportation Systems in a Contemporary Context

Modal characteristics and review of transportation technology, land use and transportation interaction, principles of transportation planning, introduction to transportation and traffic engineering, evaluating transportation system alternatives, local and regional transportation plans.

COURSE TS-410. Analytical Techniques in Transportation Studies

Study design, basic quantitative capabilities in problem solving, computer modeling in transportation, survey methodology, operations research in transportation, maps and graphics use in transportation analysis and presentation, environmental-impact analysis in transportation.

COURSE TS-420. Efficient Use of Existing Public Transportation Systems

Developing for more efficient use of transport facilities, economic strategies, management and control of motor vehicles, relation of roads to transit systems, providing for pedestrians and bicyclists, urban goods movement.

COURSE TS-430. Transportation System Functional Design and Development

Collection, distribution, and internal circulation services; routing, scheduling, and dispatching of transit vehicles; fare-collection systems and policies; passenger information systems and services; park-and-ride, shuttle-transit, and express-bus service; paratransit systems and implementation; application of effectiveness evaluation to transit strategies; rural transportation planning, systems, and implementation.

COURSE TS-440. Transportation Systems Operational Management

Transit system management procedures, techniques for