

*Summer Experiential Learning Program
for Diverse Student Populations
Year One*

by

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EXECUTIVE SUMMARY

This report describes the transportation workshops conducted during June of 1993, under the Summer Experiential Learning Program for Diverse Student Populations. The goal of this project was to provide an opportunity to interest minority students in the region in pursuing a college education in the field of transportation. The workshops were designed to illustrate the diverse and challenging nature of transportation and value of transportation to diverse populations. The workshops were designed to provide a positive learning experience and to increase the confidence of the students that they could successfully pursue a degree and career in this field.

This project was combined with an ongoing summer workshop activity organized by Dr. Omnia El Hakim at Fort Lewis College, Durango, Colorado. Dr. El Hakim has established a summer math and science program for high school and middle school students sponsored by the National Science Foundation and other organizations. This project was also assisted by the T3 Center for Native Americans at Colorado State University. The existing workshop format established by Dr. El Hakim was modified to include a variety of transportation related workshop activities.

Workshops were conducted at both Fort Lewis College and Colorado State University. Workshops at Fort Lewis College included discussions of the use of science and math in the design and operation of safety features of highways, computer based workshops where the students used spreadsheet models to solve typical highway geometric design problems, and a student conceptual design activity to organize a transportation system for a future tourist center. A field trip was provided to the local district office of the Colorado Department of Transportation (CDOT).

Workshops at Colorado State University included discussions on bridge design principles, a bridge building contest for the students, discussions by a local transportation consultant, and a tour of the Structures Testing Laboratory at the Engineering Research Center at Colorado State University. A field trip was provided to the Headquarters of the CDOT in Denver.

The transportation workshops were well received by the students. Suggestions to improve future workshops include more hands on exercises, such as the bridge building contest, better videos and slides more suited to this audience and improved interactive, fun transportation based software.

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CHAPTER 1

INTRODUCTION

Most universities in the United States have difficulties in recruiting minority students. This is especially difficult for math, science and engineering programs. The purpose of the summer experiential workshop described in this report was to recruit potential future students for the field of transportation engineering. Transportation engineering and management are not fields that students necessarily perceive as attractive. Both advantaged and disadvantaged populations alike generally take the transportation infrastructure for granted. Not much glamour or professional career excitement is normally associated with the construction and maintenance of a roadway system. Minority students are more likely to be attracted to fields such as medicine, education or the law that seem to have more direct impacts on their families and neighborhoods. Therefore, workshops for potential college students must provide not only an overview of the field that excites the imagination of the student. In addition, the potential student needs to be assured that they can be successful in college and as a future professional in the field.

At the time this workshop project was originally proposed, the target audience for the workshop was envisioned to be first and second year college students, specifically those from junior colleges that might be recruited to transfer into transportation engineering programs offered in the region. A one week workshop was planned. However, an opportunity arose to combine this summer workshop activity with a similar activity being organized by Dr. Omnia El Hakim at Fort Lewis College in Colorado. Dr. El Hakim had previously organized and conducted, under National Science Foundation and other sponsorship, a summer math and science program for diverse populations. Middle school and high school students were the targeted audience for the workshop. By combining this Mountain Plains Consortium project with the activity by Dr. El Hakim, the use of the resources was maximized. A third organization, the T3 Center for Native Americans also joined the project and contributed significantly to this project. This center is operational within the CSU System (CSUS) and partners with CSU, Ft. Lewis College and the tribal governments. It is physically located on the campus of Colorado State University under the directorship of Alex Ariniello. The Colorado State University T3 Program is one of four nationwide that were established under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Eastern Washington

University, under the directorship of Dick Winchell; Michigan Technological University, under the directorship of Bernie Alkire; and Montana State University, which has no director at this time; house the other three. All four transportation centers are available to help develop similar workshop efforts.

The combined effort allowed the project to reach a much larger group of potential transportation students over the two week period. The workshops originally designed by Dr. El Hakim to cover general engineering subjects, were modified to include workshops on transportation. A copy of the program brochure, including a complete list of sponsoring organizations is shown in Appendix A. Also included in Appendix A is a copy of a newsletter article about the program.

The change in the nature of the targeted student group is consistent with the needs of the Mountain Plain Consortium to address the transportation needs of diverse populations in the region. An advantage of combining this effort with that of Dr. El Hakim is a return student pool. Dr. El Hakim makes every effort to invite previous student participants to continue with future summer workshops. That allows, for example, middle school participants to come back in future years as high school students. This further allows these returning students to get expanded information on the transportation field.

Because of the nature of the student participants and the need to interface with general math and science activities, the focus of the transportation elements of the summer program was to show how math and science are an integral part of transportation engineering. Another important perspective was to focus on elements of transportation safety that relate to the individual's well-being. For example, the workshops explained the safety consideration in designing highways curves, roadside signs and operation of traffic signals.

As shown in the program announcement in Appendix A, the complete program lasted three weeks. The first two weeks were at Fort Lewis College in Durango, Colorado, and the last week was at Colorado State University in Fort Collins, Colorado. During the portion of the program at Fort Lewis College, 30 middle school students and 60 high school students participated. Only the 60 high school students participated in the week at Colorado State University. The student group was composed of 75% Native Americans and 55% females. See Appendix A for listing of the students.

CHAPTER 2

FORT LEWIS COLLEGE WORKSHOPS

The transportation workshops at Fort Lewis College in Durango, Colorado, were held during the week of June 7 - 11, 1993. Wednesday, June 9, both the middle school and high school students participated in a one day field trip to the Colorado Department of Transportation District Office in Durango. This was designed as an initial activity to raise the participants' awareness of what is involved in transportation design, planning and system management. Thursday and Friday, June 10-11, two workshops were held for the high school students and one workshop for the middle school students. Each workshop session for the two groups of students was begun with an introduction to the Mountain Plains Consortium (MPC) and the role of the MPC in sponsoring these workshops.

High School Workshops

Two kinds of workshops were organized for the high school students. One workshop focused on safety features of highways and safety in construction and was conducted by the author. The format for this workshop was one of discussions centered on videos and transportation slides obtained from the Colorado State University Transportation Technology Transfer Center. Figure 2.1 illustrates the format for the workshop. The workshop was organized to show that the design of safety features is based on physics and scientific experimentation. Thought was given to selecting videos that were entertaining without being too visually graphic. Graphic accident scenes were avoided taking into consideration the age of the students and the cultural sensitivity based on certain Native American customs. For example, a video on mail box supports (developed by the Federal Highway Administration) was selected since it showed crashes of remotely controlled vehicles with a minimum of actual accident photographs. Also, a heavy equipment safety video was selected because it used humor to illustrate the safety principles. Following the videos, slides of roadside obstructions (good and bad examples) were shown and the students were asked to discuss them. In particular, students were asked to recall specific incidents from their own neighborhoods that they could discuss. The students' participation was excellent.



Figure 2.1 Dr. D.G. Fontane Leading Discussions of Highway Safety Features

Finally, the author showed personal slides of bicycle facilities. Since the high school students ride bicycles, they could more easily identify with these facilities. The design and operation philosophy of these facilities was discussed so that the students could appreciate the science and engineering considerations. This was an extremely successful portion of the workshop since many students had previously little idea of how to properly use these facilities.

The second workshop was a computer based one on basic equations for stopping sight distance, horizontal and vertical curve design, maximum speed and drag calculations and queuing at traffic bottlenecks. The author conducted the workshop jointly with Suzan Hutchinson of the Colorado Transportation Technology Transfer Centers and the Colorado T3 Program for Native American Center. The workshop was organized to let the students experience using the computer to solve actual transportation problems. Transportation problems were selected from the senior level Transportation Engineering course, CE 478, taught at Colorado State University. Allowing the high school students to solve problems used in a senior level university course is a successful learning activity for building confidence in their ability to perform in a university setting.

The author developed QUATTRO PRO spreadsheet templates specifically for this workshop to solve each problem in the workshop. The students had previously received one day of instruction in the

use of the spreadsheet software. Problems solved by the students are shown in Appendix B and the spreadsheet templates used are included in Appendix C. The templates, as illustrated in Figure 2.2, contained the basic description of the required equations and a structured organization to solve these equations.

	A	B	C	D	E	F	G
1		CE 478 TRANSPORTATION ENGINEERING					
2		HORIZONTAL AND VERTICAL CURVE CALCULATIONS					
3		FALL 1992					
4							
5	The Basic Equations for Horizontal Curves Based upon SSD are:						
6							
7	Eqn. (1) $SSD = (Rv/28.65)*[\arccos\{(Rv - Ms)/Rv\}]$						
8							
9	Eqn. (2) $Ms = Rv*[1 - \cos\{(28.65*SSD)/Rv\}]$						
10							
11	where SSD = stopping (sight) distance in feet						
12	Rv = Radius of the vehicle's traveled path						
13	Ms = Middle Ordinate to the vehicle's traveled path						
14							
15	Eqn. 1		Calc.		WORKING AREA		
16	Rv	Ms	SSD				
17	1994.00	24.00	619.324				
18							
19	Eqn. 2		Calc.				
20	Rv	SSD	Ms				
21	1994.00	525.00	17.256				
22							
23							
24	The Basic Equation for Horizontal Curves Based upon						
25	Centrifugal Force is:						
26							
27	Eqn. (3) $Rv = V^2/[g*(fs + e)]$						
28							
29	where Rv = Radius of the vehicle's traveled path						
30	V = Speed of the vehicle in fps (1 mph = 1.47 fps)						
31	g = gravitational constant = 32.2 f/s/s						
32	fs = coefficient of Side friction for the pavement						
33	e = rate of superelevation in f/f						
34							
35					Calc		
36	fs	e	V (mph)	V (fps)	Rv		
37	0.08	0.10	70.00	102.90	1826.848		
38							

Figure 2.2 Portion of a Spreadsheet to Compute Horizontal Curves

The computer laboratory at Fort Lewis College is equipped with a color projection system such that the display on the instructor's computer is projected on a screen for viewing by the whole class. Students, seated at individual computers, could reproduce the instructor's entries and key strokes on their machines. The instructor would explain the basic transportation engineering concepts underlying the solution of the problems. This process is illustrated in Figure 2.3. He would demonstrate the solution to one problem. Then, the students would solve the rest of the similar problems on their own. Since the students had already been introduced to the spreadsheet software, they had little difficulty in solving these problems.



Figure 2.3 Dr. D.G. Fontane Describing a Sight Distance Problem

The students were extremely comfortable using the computer and really participated in the workshop. Figure 2.4 shows Suzan Hutchinson assisting students in this workshop. The workshop covered a period of 2 and a half hours with an intermediate refreshment break.



Figure 2.4 Suzan Hutchinson Assisting Students

Middle School Workshop

This workshop was divided into three parts. It was jointly taught by the author and Suzan Hutchinson. The first part was an overview of traffic signals, signage and markings from the view point of pedestrian and bicycle safety. The presentation was based upon the authors personal slides used in the Colorado State University Transportation Engineering course. It was felt that middle students could easily relate to pedestrian and bicycle components of transportation systems. For example, the way that a traffic signal works and the importance of using the pedestrian push button were emphasized. Also slides of bike lanes were shown and the students were asked to discuss the proper turning movements, and other aspects of bicycle operation. The instructors asked the students direct questions to keep their involvement in the workshop high.

The second part of the workshop consisted of transportation related slides taken by the author in various international locations as Brazil, People's Republic of China, Dominican Republic, India and Yugoslavia. The intent was to make the students aware of the impacts of culture on the transportation system. Cultural influences were discussed and the students were asked to give their views on their own culture and transportation. A short questionnaire was administered to the students that asked the following three questions:

- 1) What is it that you love to do?
- 2) What would you love to do for the rest of your life?
- 3) How can you use what you love to do to help your tribe?

A summary of the responses to these questions is shown in Appendix D.

The third part of the workshop was an exercise in which the students were given a basic layout for which a tourist center is to be designed. Tourist centers are an important issue for Native Americans in this region. The students were asked to design a one-way path from the main entrance to the visitors' center, around a park and back to the entrance. Various modes of transportation, walking, biking, water transportation, bus and rail, were to be incorporated in the design. They had to consider topographical obstacles and decide how to handle them. For example, the water raft trip should be downstream rather than upstream. If students attempted to cross mountains in a straight line, then aspects of grade and use of the contour were discussed. The students were divided into teams of four to five individuals and they drew their designs on large posters. The class then shared their designs and had their pictures taken with their posters, as illustrated in Figures 2.5 and 2.6. In addition, the posters were displayed for the parents at the final banquet.



Figure 2.6 Tourist Center Design Team



Figure 2.5 Tourist Center Posters

CHAPTER 3

COLORADO STATE UNIVERSITY WORKSHOPS

The transportation workshops were held at Colorado State University during the week of June 14 - June 18, 1993. Figure 3.1 shows Dr. El Hakim welcoming the group. The transportation activities included: a bridge design contest, a visit to the headquarters of the Colorado Department of Transportation (CDOT), a presentation by a local minority transportation engineering consultant, and a tour of the Structures Laboratory at the Engineering Research Center at Colorado State University to display a bridge design research project.



Figure 3.1 Dr. El Hakim Welcoming Participants to Colorado State University

The first transportation activity during the week was the bridge design contest. Tuesday, June 15, Dr. Darrell G. Fontane gave the participants an overview of the upcoming transportation activities and described the role of MPC in the region. Dr. Paul Nowak, an Assistant Professor in the Civil Engineering Department at Colorado State University, described the format for the bridge design contest and presented information on basic concepts of bridge design. The students were then given demonstrations of failure of

structures under varying loads using the testing equipment in the Civil Engineering Department's Structures Teaching Laboratory.

The students were divided into design teams of approximately four members each. Each team was given a package that consisted of the same amount of balsa wood and glue. Based upon the general bridge design principles that had been explained to them, the teams were asked to design and construct a bridge. Since the bridges would vary in weight, the students understood that their bridges would be evaluated and the winning bridge was the one with the best strength to weight ratio. All the constructed bridges were photographed, as illustrated in Figure 3.2, and left to dry until Thursday, June 17. On the afternoon of June 17, all bridges were weighed and loaded to failures using the testing equipment in the Civil Engineering Department's Structures Teaching Laboratory of the Civil Engineering Department. Small monetary prizes were awarded to the top three bridge building teams who had designed and constructed the best bridges. Figure 3.3 shows one of the winning bridges.

On Wednesday, June 16, the participants were given a tour of CDOT Headquarters in Denver.

This tour was coordinated by Ms. Beth Moore of the CDOT furnished services and made to be used by the Center for Native

coordinated by Ms. CDOT. The video taping a movie of the tour Colorado T3 Americans.

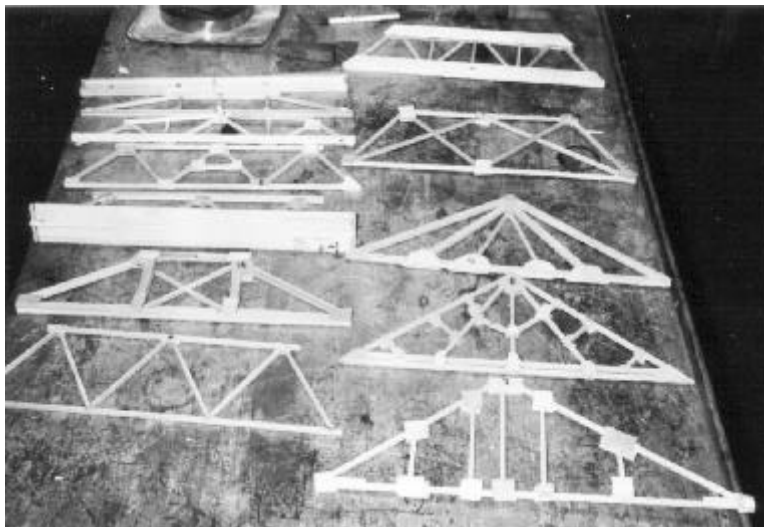


Figure 3.2 Student Bridges



Figure 3.3 A Winning Bridge Design Team

Thursday,
 transportation
 Armando Balloffet,
 participants about
 engineer's role in
 management (see
 Balloffet also
 minority-based
 offered by his firm.



June 17, a local
 consultant, Dr.
 spoke to the
 the consulting
 transportation
 Figure 3.4). Dr.
 described a
 college scholarship

Figure 3.4 Dr. Balloffet Describes Transportation Consulting

On Friday, June 18, the participants toured the Research Structures Laboratory at the Engineering Research Center at Colorado State University. Dr. Richard Gutkowski of the Civil Engineering Department at Colorado State University has ongoing large scale testing of various bridge design components. These facilities were demonstrated to the students.

CHAPTER 4

DISCUSSION AND EXTENSION

It is the opinion of the author that the transportation related workshops were very successful. The students were very open and enthusiastic about the workshops. Many shared their surprise at how interesting the transportation field was compared to their perceptions coming into the summer program. The students particularly liked the participatory activities such as the bridge building contest and the computer related activities.

A challenge that exists for the MPC is to prove to minority students groups that transportation is an area that has direct benefit for their families, communities and tribes. Most of the students wanted to choose careers that they perceive can help their communities. Doctors and lawyers are examples mentioned frequently by the students. If the transportation profession wishes to recruit from this diverse student pool, then the relevance of transportation to the good of society must be firmly established.

Suggestions to improve further workshops center in three areas; more creative participatory events, better videos and more fun computer programs. The videos that were selected for the workshops were informative, but not really aimed at the level of these students. More general transportation videos, such as the type often produced for public television are needed. Humor is also very important for this age student and it would be ideal to have cartoon-based, education videos on transportation.

The spreadsheet software was well received and the students enjoying solving real problems, particularly those that would be required in college. This was a good confidence building exercise. However, there is a need to supplement these strictly functional programs, with others that are more game-like or fun. There exists a variety of "fun" software to teach basic math, science and language and similar software is needed for transportation.

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