DEVELOPMENT OF PACTRANS WORKFORCE DEVELOPMENT INSTITUTE

Year 4 – Year 6

FINAL PROJECT REPORT

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16. Abstract

With the recent emergence of technology and its applications in transportation engineering practice, the demand for continuing education and workforce development is growing. Being the Northwest regional University Transportation Center, PacTrans also carries the task of transportation workforce development for Federal Region 10. To fulfill this task and address regional workforce development challenges, PacTrans has seen a clear need to develop an institute that provides professional training and continuing education for Region 10's transportation professionals.

Bringing together decades of collective experience in educational research and continuing education, the research team established the PacTrans Workforce Development Institute (WDI) to address increasing workforce development needs. Each university offers its own strengths in transportation research and education and thus makes unique and meaningful contributions to this project. Through survey and outreach activities, the research team has identified the gaps between workforce training needs and existing training opportunities and has developed training courses to fill these gaps. To better accommodate working professionals' busy schedules, the PacTrans WDI offers demand-responsive and flexible training services in both on-site and online settings. Specifically, the WDI has developed and delivered several training courses, such as Understanding and Applying the Manual on Uniform Traffic Control Devices, Incorporating Human Factors into Roadway Design and Crash Diagnostics, Project Management and Key Skill Capability Building, etc. In addition, the WDI is scheduled to deliver several training courses, such as Data Analytics and Tools, Geospatial Analysis for Transportation Planners and Practitioners, and An Introduction to School Zone Safety.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ABBREVIATIONS

ADA:	Americans with Disabilities Act
ASCE:	American Society of Civil Engineers
ADOT&PF:	Alaska Department of Transportation and Public Facilities
CAV:	Connected and autonomous vehicle
CPD:	Continuing professional development
DEI:	Diversity, equity, and inclusion
FHWA:	Federal Highway Administration
GIS:	Geographic information system
HCM:	Highway Capacity Manual
LMS:	Learning management system
LTAP:	Local Technical Assistance Program
MUTCD:	Manual on Uniform Traffic Control Devices
NW TTAP:	Northwest Tribal Technical Assistance Program
PacTrans:	Pacific Northwest Transportation Consortium
PNW:	Pacific Northwest
STEM:	Science, technology, engineering, and math
UTC:	University Transportation Center
USDOT:	United States Department of Transportation
UW:	University of Washington
WDI:	Workforce Development Institute
WRTWC:	West Region Surface Transportation Workforce Center
WSDOT:	Washington State Department of Transportation
WSU:	Washington State University

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EXECUTIVE SUMMARY

Transportation plays a critical role for our nation's economy. With increased transportation activities and reduced highway trust funds, however, our transportation system faces numerous challenges. Among them, the use of new technologies to enhance the efficiency and reliability of existing transportation infrastructure is quite remarkable. This involves not simply learning to use a mature technology but also processing large quantities of data and other information to develop optimal operational strategies and their supporting tools to address emerging issues. Obviously, the knowledge learned through a college education may not be sufficient to address these quickly evolving challenges. Transportation professionals need access to professional and continuing education courses and training to keep up with new knowledge and technology developments.

As the Federal Region 10 University Transportation Center, PacTrans also carries the task of transportation workforce development for the region. To fulfill this task and address regional workforce development challenges, PacTrans has seen a clear need to develop an institute that provides professional training and continuing education for Region 10's transportation professionals. Bringing together decades of collective experience in educational research and continuing education, the research team established the PacTrans Workforce Development Institute (WDI) to address increasing workforce development needs. Each university within the PacTrans consortium has its own strengths in transportation research and education and thus makes unique and meaningful contributions to this project.

To better accommodate working professionals' busy schedules, the PacTrans WDI offers demand-responsive and flexible training services in both on-site and online settings. Through survey and outreach activities, the research team identified gaps between workforce training needs and existing training opportunities and developed training courses to fill those gaps.

Specifically, the WDI developed and delivered several training courses, such as Understanding and Applying the Manual on Uniform Traffic Control Devices, Incorporating Human Factors into Roadway Design and Crash Diagnostics, Project Management and Key Skill Capability Building, and more. In addition, the WDI is scheduled to deliver several training courses, such as Data Analytics and Tools, Geospatial Analysis for Transportation Planners and Practitioners, and An Introduction to School Zone Safety.

CHAPTER 1. INTRODUCTION

1.1. Problem Statement

Transportation plays a critical role for our nation's economy. With increased transportation activities and reduced highway trust funds, however, our transportation system faces numerous challenges. Among them, the use of new technologies to enhance the efficiency and reliability of existing transportation infrastructure is quite remarkable. This involves not simply learning to use a mature technology but also processing large quantities of data and other information to develop optimal operational strategies and their supporting tools to address emerging issues. Obviously, the knowledge learned through a college education may not be sufficient to address these quickly evolving challenges. Transportation professionals need access to professional and continuing education courses and training to keep up with new knowledge and technology developments.

1.2.1 Workforce Deficiency in Transportation

Published by the Washington State Department of Transportation (WSDOT), the 2018 Gray Notebook, highlighted that with a limited annual increase rate of permanent full-time employees (4 percent) agency wide, 42 percent of WSDOT employees could retire by the year 2022 (WSDOT 2018a). Meanwhile, WSDOT also set a goal of providing leadership training to 500 employees by June 2019 to support the agency's Talent Development Strategy (WSDOT, 2018b), including the utilization of tools available at WSDOT such as the Learning Management System, Skill Soft, and the Performance Management System to support staff's growth and development. Clearly, a critical need to prepare a qualified workforce in the state DOT had been identified. Both newly employed and existing working professionals needed to be trained in order to address the inevitability of future retirements. The "2017 Washington State Employee Engagement Survey, Employer of choice" (WSEES, 2017) also stressed the value of offering responsive training for "targeted continuing education and personal growth at work" for recruiting and retaining good employees. This was based on poor responses to the questions: "*I have opportunities at work to learn and grow,*" and " *I am encouraged to come up with better ways to do things.*"

1.2.2 Insufficient Training Availability for Working Professionals

New employees have high expectations for advancement. Yet existing training opportunities seem insufficient to help prepare employees for new and changing conditions with regard to the demand for transportation and the associated technological advances. An online survey[1] conducted with working transportation professionals from Region 10 revealed that in comparison to internal training opportunities provided by organizations, chances for transportation professionals to receive external training were quite limited, for both managers and engineers).

Specific to WSDOT, the internal training program there offered several types of training opportunities for current employees, but these courses mainly concentrated on soft skill or specific project training. The WSDOT Learning Management System[2] offered mandatory training, leadership development training, and consultant services from LEAN. One example of an external training program is the WSDOT

[1] Online internet survey conducted by PacTrans to explore the training needs of working professionals in Region 10; for details please refer to the summary in the appendix.

[2] Learning Management System. (Accessed on Nov.11, 2018 at https://www.wsdot.wa.gov/employment/workforce-development/talent-development.htm)

local technical assistance programs (LTAP). These programs are mainly geared toward the national level or for state-based organizations. Programs such as LTAP tend to be fairly generalized and do not always meet all of the needs of all trainees with varied state or regional terms, rules, and even regulations. For this reason, more localized workforce development training is at high demand.

1.2.3 Understanding Gaps of Existing Training Supply and Demand

A recent deep investigation by PacTrans (2018)[3] of existing transportation workforce development training organizations, with broad coverage including federal and state-level agencies, associates or non-profit institutes, and university-affiliated training, found that there were some big understanding gaps between current training opportunities and demand from potential trainees. Specifically, even though various on-demand courses were designed and offered (some courses were duplicated), in many training institutes, working professionals' training needs were not well satisfied. For most participants, location and cost tended to drive training decisions. If travel was involved or if costs were too high, training opportunities became more challenging. Therefore, availability of requested training courses significantly influenced training opportunities for working professionals. A demand-responsive and flexible training program would be a much more effective platform for delivering advances and context-sensitive courses.

Although the continuing education program TRANSPEED at the University of Washington was popular and far-reaching, it was badly hit by the most recent financial crisis. After WSDOT and other agencies stopped their funding support, TRANSPEED closed in 2010. At that point, working transportation professionals lost easy access to continuing education, and local needs for workforce development accumulated. With the recent emergence of technology and applications in transportation practice, such as connected and autonomous vehicles (CAVs) and smart cities technologies, the demand for continuing education and workforce development has grown.

Being the regional transportation research center, the Pacific Northwest Transportation Consortium (PacTrans) also carries the task of transportation workforce development for Federal Region 10, which includes Washington, Oregon, Idaho, and Alaska. In 2016, a new dialog started between transportation agencies and PacTrans to re-establish a new workforce development program to address the increasing workforce development needs of transportation agencies and companies in the Pacific Northwest. PacTrans established the Workforce Development Institute to help provide professional training and continuing education for Region 10 transportation professionals.

1.2. Research Background

With support from WSDOT and other transportation agencies, the Department of Civil and Environmental Engineering (CEE) at the University of Washington (UW) operated a very popular continuing education program called TRANSPEED until 2010. Administered through the UW's Professional and Continuing Education program, TRANSPEED delivered professional training and continuing education in transportation engineering to governmental agencies and private firms. It conducted 50 workshops annually that served over 1,400 students. Figure 1-1 shows an example course advertisement in 2004. The offerings were all short-term courses and were delivered at different locations, such as in Seattle, Bellevue, Vancouver, and Lacey in Washington, to make it convenient for

[3] Literature review conducted by Pactrans to summarize 28 existing training organizations/institutes and organizations with 135 courses on transportation workforce development in the USA..

working professionals to participate. Figure 1-2 shows a snapshot of a TRANSPEED training session, where students had hands-on experience at such training sessions.

Instructors of the TRANSPEED courses were typically working professionals with real-world experience. Each course was designed to address some specific challenges in engineering practice.

The TRANSPEED program at the University of Washington is pleased to announce its Winter/Spring schedule of courses. TRANSPEED is a professional development program of the Civil and Environmental Engineering Department at the University of Washington. .
Upcoming TRANSPEED Courses

To view specific course descriptions and faculty check the TRANSPEED website at: http://www.engr.washington.edu/epp/transpeed/
For questions please contact: Christy Roop Pack
Program Manager
University of Washington
Engineering Professional Programs
10303 Meridian Ave N #301
Seattle, WA 98133
206-543-5539 or 1-866-791-1275 (Toll Free)
206-543-2352 FAX
croop@u.washington.edu

Roadway Safety, Analysis, Evaluation and Programming January 5-6, 2004 Seattle	Basic Highway Capacity for Engineers and Planners January 7-9, 2004 Seattle
Determining Contract Working Days January 29, 2004 Seattle, March 9, 2004 Seattle	Managing Consultants February 3, 2004 Seattle, May 11, 2004 Lacey
Concrete Bridge Design February 10-12, 2004 Seattle	Work Zone Traffic Control Plan (TCP) Design February 18-20, 2004 Seattle
Traffic Signal Timing and Operations February 23-25, 2004 Lacey	Techniques of Pavement Rehabilitation February 24-26, 2004 Seattle
Urban Street Design March 1-3, 2004 Seattle	Work Zone Traffic Control Plan (TCP) Design March 23-25, 2004 Lacey, June 14-16, 2004 Spokane
Fundamentals of Traffic Engineering March 17-19, 2004 Seattle	Legal Liability for Transportation Professionals April 5-6, 2004 Wenatchee, April 8-9, 2004 Seattle
Managing Scope, Schedule and Budget March 31-April 2, 2004 Seattle	Manual on Uniform Traffic Control Devices (MUTCD) April 14-16, 2004 Seattle
Stormwater Engineering for Transportation Professionals April 20-22, 2004 Seattle	Technical Communication for Transportation Professionals April 27-28, 2004 Seattle
Traffic Calming: Techniques and Management May 3-5, 2004 Seattle	Traffic Engineering Operations June 9-11, 2004 Lacey
Traffic Signal Design May 26-28, 2004 Lacey	

Figure 1-1 An example TRANSPEED course advertisement in 2004

Figure 1-2 A snapshot of a TRANSPEED training session

In 2016, with FAST Act University Transportation Center (UTC) funding, the Pacific Northwest Transportation Consortium (PacTrans) established a multi-year, multi-institution effort to launch the PacTrans Workforce Development Institute (WDI). Figure 1-3 shows its logo. The goal was to create a demand-responsive and flexible program to provide training services to working professionals in the Pacific Northwest, including Alaska, Idaho, Oregon, and Washington. The WDI would focus on short-term training about transportation-specific topics, emerging technologies, management and communication skills, software and modeling, and more. This goal would benefit the region in the following ways:

- offer an overloaded workforce access to desired training materials and courses at convenient times and locations, and at their own pace;
- provide a forum for working professionals and university researchers to jointly investigate challenges and opportunities associated with the new technologies, such as CAV technologies and their potential impacts, so that transportation agencies and companies could be proactive in incorporating new technologies into practice; and
- address the continuing education needs of Region 10 working transportation professionals and thus help to enhance local transportation agencies' organizational strengths and local companies' competitiveness.

Figure 1-3 PacTrans WDI logo

To address the training needs of Region 10, the PacTrans WDI aimed to provide the following training services:

- Short-term training for
  - employees from transportation agencies
  - students/practitioners looking for transportation engineering-related jobs
  - K-12 transportation-related training webinars/workshops.
- A flexible training format
  - onsite when demand was sufficient
  - online learning otherwise.
- A flexible schedule
  - self-paced, pre-recorded, interactive
  - group-based, real-time, instructor-led.

1.2.1. Better Understanding of Training Needs

The process began with PacTrans and its researchers from Oregon State University and University of Idaho designing and implementing a workforce development study that consisted of two major components: (1) interviews with local transportation offices and (2) the development and distribution of an online survey.

Phase 1: Structured Telephone Interviews

During the first phase of the research, the PacTrans team conducted structured qualitative interviews with transportation engineering managers, practitioners, and learning coordinators across Region 10. Participants were recruited through personal contacts among PacTrans consortium partner universities, as well as Internet directory searches through each of the region's state department of transportation website. Researchers also implemented snowball sampling, in which current participants helped to identify additional candidates to interview. In total, 17 participants were interviewed, including three from Washington, one from Idaho, eleven from Oregon, and two from Alaska. Interview questions asked participants to talk about three major topics: 1) their access to or awareness of training opportunities; 2)

the factors that affect whether to attend training; and 3) any perceived urgent or compelling needs within transportation engineering training. Interviews lasted approximately 15 minutes each and were conducted over the phone; they were not audio recorded, but a researcher took field notes as they were conducted for later analysis.

Key takeaways from these interviews included the following:

1. Participants tended to find out about most training opportunities through some form of email listserv.
2. As individuals began to attend training and/or join various professional societies, the opportunities to find out about training opportunities increased.
3. Some participants also noted conducting Google searches or reaching out to training coordinators, but such actions were often in response to a specific training need.
4. For most participants, location and cost tended to drive training decisions. If travel was involved or if costs were too high, training opportunities could be more challenging. Another salient factor was the relevance of the training to current workplace needs. If a training program or upcoming webinar was related to a project in the near future, the training was seen as more valuable.
5. Participants noted the importance of being able to gain practical skills that they could apply in their jobs, including hands-on training, in contrast to programs that educated about theories or rules or information that was seen as less directly applicable to current work.
6. Participants noted the importance of the presenter or organization conducting the training; some people or organizations had stronger reputations than others, and so when making choices about training, respondents said that it could be helpful to inquire about the skills or reputation of the presenter.
7. Participants voiced consistent training needs surrounding topics related to safety, operations, and maintenance.

Phase 2: Survey Development and Distribution

By leveraging the first qualitative phase (the phone interviews), the research team them formulated a survey, which was distributed using methods similar to those of the phone interviews. In total 184 individuals responded to the survey, including 63 managers and 121 practitioners. Table 1-1 provides an overview of the amount of experience reported by both managers and practitioners. All managers reported more than five years of experience in transportation engineering, broadly, while there was a wider range of experience with their current positions. Engineers tended to have less experience, both in transportation in general as well as in their current jobs.

Table 1-1 Participant experience overview

Position	**Experience in Transportation (yrs)**				**Experience in current job (yrs)**			
	<1	**1-2**	**3-5**	**5+**	**<1**	**1-2**	**3-5**	**5+**
Managers	0	0	2	63	7	11	12	3
Engineers	5	9	12	93	27	22	20	51

In terms of disciplines represented within transportation engineering, results suggested a relatively diverse groups of concentrations in specific fields. Table 1-2 provides an overview of the fields reported by managers and engineers. In this case, respondents could select several responses at the same time,

depending on the nature of their work. Notable here was the high proportion of "Design" as a discipline, suggesting that such activities might be common across other areas of focus. In terms of responses to "Other," participants tended to note more specific subdisciplines of transportation engineering, such as right of way or hydraulics or bridges.

Table 1-2 Overview of discipline areas for managers and engineers

Position	**Traffic**	**Highway**	**Safety**	**Construction**	**Design**	**Consulting**	**Other**
Managers	26	27	16	20	32	19	15
Engineers	38	53	30	34	56	18	32

The results from the survey provided triangulation and corroboration for findings from Phase 1 (interviews) and also pointed to some potentially interesting trends:

1. The most important criteria for determining whether someone will attend training often comes down to cost and location, but the choice is also driven by the relevance of the training topic to an upcoming project or job. That is, most respondents do not think about training needs on broad scales or in terms of larger trajectories of the field but instead make choices related to the immediacy of a need for training or a specific type of competence or certification.
2. When seeking training, managers and engineers often utilize the same sources, and they prioritize training in similar ways. However, some gaps may exist between engineers and managers in terms of desired training needs that are not available. Whereas managers emphasize professional development related to leadership or management or training, practitioners often link their perceived training needs to more specific kinds of skills or tasks (e.g., software, design for particular kinds of roads, etc.).

Outcomes from Interviews and Surveys

On the basis of the combined results of the interviews and surveys, the research team summarized programs and topics as outlined in Table 1-3.

Table 1-3 Proposed programs of training on transportation topics

Programs	**Specific transportation topics**
Americans with Disabilities Act (ADA)	Practical ADA in transportation (general introduction of standard application of ADA design in transportation, and exceptions to standard situations)
	ADA and transportation facilities: management and control
	ADA design for temporary traffic control
	Advanced ADA design for future transportation management, advanced ITS technology assistance
Advanced technology applications on transportation system management and operations (TSMO)	Multimodal transportation systems
	Complete street: active transportation and demand management
	Emergency transportation operations
	Smart city neighborhood design with CAVs, shared autonomous vehicles, and electric assisted vehicles
Series courses of manual updates, e.g., Highway Capacity Manaul (6th Edition), Highway Safety Manual, Highway Design Manual	Geometric design for urban transportation systems
	Rural transportation system design
	Highway transportation design (based on the Highway Capacity Manual)

Programs	Specific transportation topics
	Safety management and risk evaluation in design

The survey also identified that specific transportation-related courses from each program could be mixed and matched with courses related to advanced technology skills (with a focus on software and modeling techniques) and soft skills (with a focus on management and communication techniques) In addition, trainee participation in these offerings could provide more opportunities to favor each individual's personalized tastes.

1.2.2. WDI Infrastructure Development

Simultaneously with the interview and survey tasks, other team members worked to develop the necessary infrastructure to accomplish the desired tasks.

The research team developed a website (https://pactranswdi.org/) as the online training platform for marketing and outreach activities, the training schedule, payment, and registration.

They also created an infrastructure that allowed in-person, synchronous, and asynchronous course delivery. The e-learning service that the PacTrans WDI created was based on Zoom as the online conferencing tool and Canvas as the learning management system (LMS). The research team utilized infrastructure developers who developed the LMS with specific learning modules and functions that catered to instructors' requirements. This was also done, in part, because during the COVID-19 pandemic, the only realistic option for course delivery was virtual.

1.2.3. WDI Launch and Early Training Courses

With training needs identified through the interviews and survey, and with the infrastructure in place, the WDI officially launched, on February 23, 2021, during its inaugural training course that was held in partnership with the WSDOT, titled *Understanding and Applying the Manual on Uniform Traffic Control Devices*. Figure 1-5 shows the LMS with a recording of the launch and the first lesson of the inaugural course.

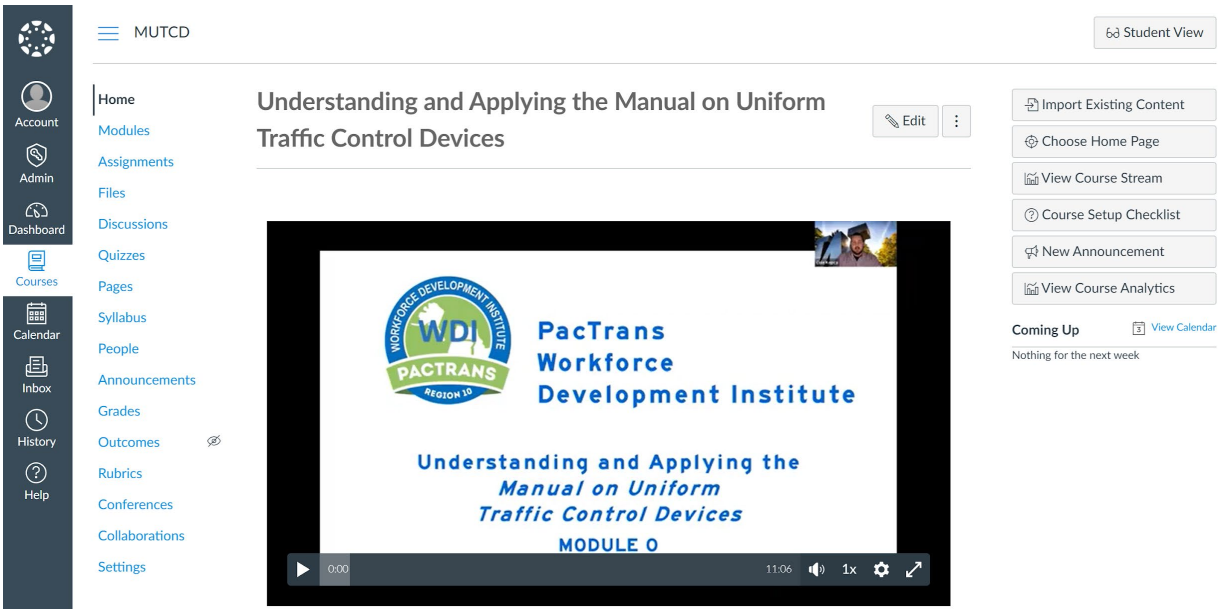

Figure 1-5 Home page for training course

On the basis of the training needs and demands identified through previous survey and outreach activities, the research team worked on the development of training courses that addressed the immediate training needs of local transportation agencies/companies. The research team, with each university offering its own strengths in transportation research and education, worked together to accomplish this task. Courses included the following:

1. Understanding and Applying the Manual on Uniform Traffic Control Devices (MUTCD).
2. Incorporating Human Factors into Roadway Design and Crash Diagnostics.
3. Transportation Data Analysis and Tools - The content for this series of courses has been developed but not yet delivered.
4. Project Management and Key Skill Capability Building - The content for this series of courses has been developed but not yet delivered.
5. School Zone Safety and Safe Routes to School - The content for this series of courses has been developed but not yet delivered.
6. Geospatial Analysis for Transportation Planners and Practitioners - The content for this series of courses has been developed but not yet delivered.

1.3. Research Objectives

The objective of this project was to continue to build and expand a demand-responsive and flexible program, namely, the PacTrans Workforce Development Institute (WDI), for transportation workforce development in the Pacific Northwest. This phase of the work included an emphasis on K-12 science, technology, engineering, and mathematics (STEM) outreach integrated into the Institute. Deliverables of this project would include the following:

- Design of the administrative structure, funding sources, and business model;
- Curriculum and candidate instructors for each training course;
- A full set of course materials, including lecture notes, assignments, projects, and exams, for each training course;

- An official website for the PacTrans WDI for promotion, course schedule, and registration;
- A summer transportation campus for high school students;
- A summer transportation-related course for middle school students; and
- A final research report for this project.

The proposed workforce development program would benefit transportation working professionals in the following three aspects:

- It would allow busy working professionals to access desired training materials and courses at their convenient time and locations, and at their own pace;
- It would provide a forum for working professionals and university researchers to jointly investigate challenges and opportunities associated with the new technologies, such as CAV technologies and their potential impacts, so that transportation agencies and companies could be proactive in incorporating the new technologies into practice; and
- It would directly address the continuing education needs of transportation agencies and companies and thus be critical for enhancing their organizational strength.

Meanwhile, the proposed K-12 STEM outreach activities would benefit the transportation industry as a whole in the following two aspects:

- Expose students to new and exciting topics in transportation so they understand the breadth of opportunities in transportation-related careers; and
- Encourage students to pursue classes, extracurricular activities, and hobbies in transportation-related topics.

1.4 References

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CHAPTER 2. LITERATURE AND STATE OF PRACTICE REVIEW

2.1. Background

Employee training supports the collective knowledge base of an agency or company and ensures that staff are educated or equipped with the latest or the most pertinent information needed to complete a project or activity. This training, which can categorically fall under the broad umbrella of workforce development or continuing education, includes topics that range from discipline-specific to organizational dynamics, and it can be presented in a wide variety of formats such as in-person presentations, hardcopy materials, or as an online offering.

Individual employees are faced with the responsibilities of completing day-to-day tasks, managing assignments, and making certain that their knowledge base is current. The challenge of identifying and understanding new information and requirements can be significant to the employee. Larger organizations must recognize that the provision of training comes with balancing training needs with each agency's priorities. When and how frequently should an employee be entitled to training opportunities? How does the agency recover its investment? What are the agency's philosophies and overall budget allocation with regard to training? What are the philosophies of individual managers and supervisors? (Chang, 2015)

For civil (and transportation) engineers, there is added recognition that "civil engineers must learn and apply new technologies that (may not have been) included in a traditional (academic) curriculum. (Lipinski, 2005) This is becoming more and more relevant as intelligent transportation systems and the evolution of autonomous and connected vehicles increasingly cross the learning pathways between the majors of civil engineering, computer science and engineering, and human psychology. The lack of workforce development "supporting improved systems operational management is becoming a more serious constraint to improving mobility … and the demand of new technologies on staff capabilities has also been recognized in ongoing professional capacity building efforts at the United States Department of Transportation and in some university curricula" (Lockwood and Euler, 2016).

As recently as March 2017, the American Society of Civil Engineers' (ASCE) Board of Direction adopted a new policy statement suggesting that student learning at the college level should be expanded.

"ASCE supports the attainment of the Civil Engineering Body of Knowledge for entry into the practice of civil engineering at the professional level (i.e., practicing professional engineer) through appropriate engineering education and experience, and validation by passing the licensure examinations. To that end, ASCE supports an increase in the amount of engineering education, such that the requirements for licensure would comprise a combination of:

- "A baccalaureate degree in civil engineering;
- "A master's degree in engineering, or no less than 30 graduate or upper level undergraduate technical and/or professional practice credits or the equivalent agency/organization/ professional society courses which have been reviewed and approved as providing equal academic quality and rigor with at least 50 percent being engineering in nature; and
- "Appropriate experience based upon broad technical and professional practice guidelines which provide sufficient flexibility for a wide range of roles in engineering practice.

"ASCE encourages institutions of higher education, governments, employers, engineers, and other appropriate organizations to endorse, support, promote, and implement the attainment of an appropriate engineering body of knowledge for individual engineers" (ASCE, 2018).

The Transportation Education Council of the Institute of Transportation Engineers one year earlier undertook a complementary effort to identify employers' opinions on expectations and desires for a transportation engineering degree program. This effort involved conducting an initial assessment to identify key characteristics that employers are looking for in new graduates entering the transportation engineering field, with "willingness to learn" identified as the highest-ranked item. People skills, writing skills, and general analytical skills were also listed as important characteristics. When queried on exposure to technical subject matter taught at universities, practitioners highlighted two topics: familiarity with the Manual on Uniform Traffic Control Devices (MUTCD) and intersection capacity and level of service analysis. Other topics rated as medium to high importance included, but were not limited to familiarity with the Highway Capacity Manual (HCM), pedestrians and bicycles (complete streets), traffic signal phasing and timing, and horizontal and vertical roadway design (Hawkins and Chang, 2016).

These examples highlight the importance of making certain that young professionals are exposed, both in breadth and depth, to essential technical competencies and, when appropriate, additional learning in the form of workforce development training or continuing education. It is also important to note that workforce development consists of not only increased knowledge but also the role of mentorship and other professional-related opportunities (Martin and Glenn, 2002).

In terms of training delivery methods, a broad range of offerings is available, and with the advent of technology, opportunities to "bring" the training to the employee is becoming much more prevalent. Table 2-1 shows a list of common methods. Each method offers its own advantages and disadvantages and is generally influenced by costs associated with travel or staff time, the timeliness of the information provided, the expertise provided by the individual or individuals leading the training, and the resulting learning format, which may or may not be conducive to a particular individual (Chang, 2015).

Table 2-1 Advantages and disadvantages of specific methods

Method	Advantages	Disadvantages
Presentations (live and virtual)	Opportunity for interaction and discussion; affords participants the flexibility to ask questions and clarify understanding.	Presenters must be able to effectively communicate and provide useful information; requires travel by participants (live presentations).
(Hands-on) Training	Opportunity for interaction; allows participants to ask questions; opportunity for attendees to learn; environment creates knowledgeable staff and workforce.	Schedule conflicts; can be difficult to establish balanced training across all staff members; details much match need; can be expensive.
Webinars	Reduces or eliminates travel time; can reach a larger audience; recorded or archived presentations can be reviewed; duration can be flexible.	Lack of interaction between presenter and audience; typically requires an internet connection and software application; difficult to implement hands-on activities.

Method	Advantages	Disadvantages
Videos	Can be viewed at the discretion of the user; content to be accessed by a large audience (i.e., YouTube); more lively than written documents.	May not necessarily be relatable to user; content and perspectives can become outdated over time; production costs could be significant.
Handbooks	Comprehensive; can be used as a reference guide; contains useful information provided in a detailed manner.	Printing costs (for hardcopies); may not be used regularly; exhaustive to read; bulk can be intimidating.
Decision-Support Tools	Provides information that is conducive to making an informed decision; allows users to apply knowledge developed from past experiences at a broad level.	May require extensive use of technology and learning; reliance on good data can be restrictive; larger systems can be cost-prohibitive.
Community of Practice Support	Participants share common interest; team-oriented environment; multiple opportunities for networking and interaction.	Participants may lack the necessary skills and background; organizations must develop a clear understanding of how knowledge will be applied in practice.

It should be re-emphasized that among the methods listed in Table 2-1, the program development of and long-term commitment to online programs are often expensive and cost-prohibitive despite their increasing popularity (Mason, 2003). For example, the Global Road Safety course at the University of Iowa had found success as an in-person, academic credit-based course. However, when consideration was given to developing an online, interactive version open to parties outside of the university, cost (associated with registration and the registration process itself) and scheduling challenges grounded the effort. For these reasons, a short-course format was ultimately "found to be much more successful in attracting participants" (Hamann and Peek-Asa, 2017). A separate study noted that "some of the most important considerations of successful online training programs (for staff at a state department of transportation) are: (a) the inclusion of interactive components within the training modules to keep participants engaged, (b) a short duration for each of the training modules to retain participants' attentiveness, and (c) the provision of quizzes to assess participants' understanding of the material" (Islam, 2017).

This study further acknowledged that an effective online training program can "develop the skillset of personnel both efficiently and effectively, and help facilitate capacity building of transportation professionals." A majority of the departments of transportation (DOTs) that were interviewed acknowledged that online training was required of their employees, suggesting that DOTs were "making online training programs as a part of their capability building efforts" (Islam, 2017).

To address workforce development needs, particularly as they relate to transportation-related topics, the Federal Highway Administration (FHWA), in partnership with the United States departments of Labor and Education, established five regional transportation workforce centers to enhance transportation workforce development more strategically and efficiently; establishment of these centers arguably represents one of the first concerted efforts to consolidate and prioritize the need for such training opportunities. These centers are designed to "create, coordinate, and facilitate partnerships with State departments of transportation and education, industry, and other public and private

stakeholders to enhance transportation workforce development throughout the education continuum," and these centers also "facilitate middle school and high school activities, training in technical schools and community colleges, universities, and post-graduate programs, and professional development services for incumbent transportation workers" (Martin, 2015). The Pacific Northwest is served by the West Region Surface Transportation Workforce Center (WRTWC) at the Western Transportation Institute at Montana State University in partnership with the Upper Great Plains Transportation Institute.

The WRTWC is not alone in offering training. In fact, within the transportation (safety) domain, there are a plethora of entities that currently offer training in a wide range of topics. In the examples shown below, federal agencies, state-level agencies, associations and non-profits, university-affiliated centers and programs, and other entities are listed. Although this summary does not represent an exhaustive list, the breadth of offerings available suggests that workforce development and continuing education opportunities are indeed plentiful to the interested consumer.

2.1.1. Federal Agencies

National Operations Center for Excellence

Website: transportationops.org

The National Operations Center for Excellence (NOCoE) is a partnership of the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the Intelligent Transportation Society of America (ITSA), with support from the FHWA. NOCoE features an Operations Technical Services Program, funded through contributions from state transportation agencies and FHWA, to provide peer exchange webinars, training, capacity building programs, and practice area forums.

National Center for Rural Road Safety

Website: ruralsafetycenter.org

The Natural Center for Rural Road Safety, or Safety Center, was "created to identify the most effective current and emerging road safety improvements and deploy them on rural roads." The Safety Center currently hosts a free webinar each month; topics include "Creating a Rural Transportation Planning Organization" and "Sharing the Road with Slow Moving Vehicles." Multiple archived webinars are available for viewing, and the center sends out a weekly email about traffic safety events available through other organizations.

National Transportation Safety Board Training Center

Website: www.ntsb.gov/Training_Center/Pages/TrainingCenter.aspx

The National Transportation Safety Board (NTSB) Training Center "provides training for NTSB investigators and others from the transportation community to improve their practice of accident investigation techniques." Attendance is primarily limited to parties related to NTSB investigations, safety or law enforcement members, or members of the academic community working on relevant research projects. Courses range in length from one day to as long as two weeks.

Transportation Safety Institute (US Department of Transportation)

Website: www.transportation.gov/transportation-safety-institute

The Transportation Safety Institute (TSI), which is part of the United States Department of Transportation, provides training to "safety professionals in federal, state and local government agencies and the private industry." Offerings include face-to-face courses, live online courses, and general online courses. TSI courses cover all major modes of transportation, including general automobile, bus, rail, and aviation and in both passenger and freight hauling. It should be noted that the National Highway Traffic Safety Administration (NHTSA) training center is folded under the TSI's Highway Safety Division. Training is offered in several different forms and includes online classes on topics such as "Milestones of Highway Safety," "History of Impaired Driving," and "History of Speed Program Management." NHTSA also has a dedicated website that provides short articles on various safety topics such as teen driving, pedestrian and bicycle safety, and motorcycle safety.

National Highway Institute

Website: www.nhi.fhwa.dot.gov/about-nhi

The National Highway Institute (NHI), which represents the training and education branch of the FHWA, was established in 1970 and seeks to improve the "conditions and safety of our nation's roads, highways, and bridges [by] continuously building on the skills of highway professionals and enhancing job performance in the transportation industry across the country." The program offers courses in eighteen transportation industry program areas; course examples include Roadside Safety Design (instructor-led training) and the safe and effective use of law enforcement personnel in work zones (web-based training).

Federal Motor Carrier Safety Administration

Website: www.fmcsa.dot.gov/

The Federal Motor Carrier Safety Administration (FMCSA) was established within the Department of Transportation in 2000. The mission of the FMCSA is to prevent commercial motor vehicle-related fatalities and injuries; activities include increasing safety awareness. The FMCSA works with federal, state, and local enforcement agencies, the motor carrier industry, and labor and safety interest groups. The majority of courses are not oriented to driver training but are designed to serve law enforcement officers.

Intelligent Transportation Systems (USDOT)

Website: www.pcb.its.dot.gov/default.aspx

The Intelligent Transportation Systems Joint Program Office offers the ITS Professional Capacity Building Program (ITS PCB) to provide the ITS workforce with "flexible, accessible ITS learning through training, technical assistance and educational resources. The program assists transportation professionals by developing their knowledge, skills, and abilities to build technical proficiency while furthering their career paths." The ITS PCB hosts training courses and features an archive of nearly 200 online webinars on topics such as automated and connected vehicles and other transportation technology.

2.1.2. State-Level Agencies

Florida T2 Center

Website: www.techtransfer.ce.ufl.edu/t2ctt/default.asp

The Florida Transportation Technology Transfer (T2) Center is part of the University of Florida Transportation Institute (UFTI). The T2 Center provides training, technical assistance, technology transfer services, and safety information to transportation, public works and safety professionals, and the general public. Its mission is to "transform engineering research and technology into common practice and to foster a safe, efficient, environmentally sound transportation system by improving skills and knowledge." Program offerings include its Local Technical Assistance Program (LTAP), Pedestrian and Bicycling Safety Resource Center (SRC), Florida Occupant Protection Resource Center (OPRC), and Technology Transfer Support.

Minnesota DOT

Website: www.dot.state.mn.us/trafficeng/education/index.html

As a state-level example, the Office of Traffic, Safety and Technology in the State of Minnesota "establishes guidelines and procedures [by building] relationships between state, county and city engineering staff to resolve questions about engineering and roadway safety." The Minnesota Department of Transportation provides technical leadership and works closely with professionals to identify professional continuing education needs. An online database is dedicated to traffic engineering with webinars (mostly free) and learning modules that are divided into specialty areas ranging from basic road work safety to traffic management plans.

Minnesota LTAP

Website: www.mnltap.umn.edu/training/online/

The mission of the Minnesota Local Technical Assistance Program (LTAP), in partnership with the University of Minnesota, is to "improve the skills and knowledge of local transportation agencies through training, technical assistance, and technology transfer." The LTAP provides both online training and workshop opportunities. Course topics range from work-zone traffic control to sign maintenance and management to gravel road maintenance and design.

Technology Transfer Program California

Website: www.techtransfer.berkeley.edu

The Technology Transfer Program is the California transportation community's source for professional training, expert assistance, and information resources and is a division of the Institute of Transportation Studies at the University of California, Berkeley. The program "provides training, workshops, conferences, and technical assistance in the transportation-related areas of planning and policy, traffic engineering, project development, infrastructure design and maintenance, safety, environmental issues, complete streets, multimodal transportation, railroad and aviation."

Transportation Training Academy, University of Virginia

Website: uva-tta.net

The University of Virginia's Transportation Training Academy (TTA) provides local transportation professionals across Virginia with knowledge to design safe and efficient transportation systems. The TTA offers "informative, innovative, and affordable training and professional development programs tailored to meet the workforce development needs of Virginia's state and local government agencies in order to improve the level of transportation services provided to the traveling public." The vast majority of TTA's events are on-site training, but there is a limited availability of online materials, webinars, and training videos.

2.1.3. Associations or Non-Profits

American Society of Civil Engineers

Website: www.asce.org/education_and_careers/

The American Society of Civil Engineers (ASCE) is a "leading provider of technical and professional conferences and continuing education, the world's largest publisher of civil engineering content, and an authoritative source for codes and standards that protect the public." Training opportunities are provided in the form of four different types: webinars, seminars, guided online courses, and on-site training. Most courses broadly focus on civil engineering-related topics as opposed to exclusively focusing on transportation or traffic. Specific examples include 90-minute webinars, one- to three-day seminars, and guided online courses of six to twelve weeks featuring video lectures, interactive exercises, case studies, live webinars, and weekly discussion topics.

Institute of Transportation Engineers

Website: www.pathlms.com/ite/

The Institute of Transportation Engineers (ITE) is "an international membership association of transportation professionals who work to improve mobility and safety for all transportation system users and help build smart and livable communities. Through its products and services, ITE promotes professional development and career advancement for its members, supports and encourages education, identifies necessary research, develops technical resources including standards and recommended practices, develops public awareness programs, and serves as a conduit for the exchange of professional information." Many of its webinars are tailored to transportation engineers or an engineering audience.

American Traffic Safety Services Association

Website: www.atssa.com/TuesdayTopics

The core purpose of the American Traffic Safety Services Association (ATSSA) is to advance roadway safety. Its members "accomplish the advancement of roadway safety through the design, manufacture, and installation of road safety and traffic control devices" and the association "brings together members, road safety experts, and public agencies to identify and solve road safety issues. [Its] primary focus is to move Toward Zero Deaths on our nation's roads." ATSSA offers many transportation-related courses, ranging from certification to training to webinars, and online training is available for flagger training to an introduction of the MUTCD. One particular training opportunity, Tuesday Topics, offers

30-minute webinars that are focused on the roadway safety industry, traffic control, and innovative technologies, among other subjects.

ITS America

Website: www.itsa.org

The members of ITS America are "leading the technological modernization of our transportation system by supporting the research, deployment, and public policy for the future of intelligent transportation systems. Collaboration [exists] between private companies, public agencies, research institutions and academia while educating the public about the importance of intelligent transportation systems." The mission of ITS America is to "create a policy environment that drives ITS and Internet of Things development and deepens industry engagement." ITS America's annual showcase event is its annual meeting, which features presentations on vehicle connectivity, electrified vehicles, and other topics. Through its Knowledge Center, webinars, reports, and a technology scan and assessments are available.

National Safety Council

Website: www.nsc.org/learn/Safety-Training/Pages/defensive-driving-driver-safety-training.aspx

The National Safety Council is a nonprofit, safety advocacy organization with the mission of "eliminating preventable deaths at work, in homes and communities, and on the road through leadership, research, education and advocacy." The NSC focuses on preventing injuries and deaths at work, in homes and communities, and on the road. With regard to roadways, NSC focuses on distracted driving, teen driving and driver training. NSC pioneered defensive driver education and trains many drivers each year to become safer drivers. The Council leads Road to Zero, the national initiative aiming to eliminate traffic fatalities within 30 years.

Commercial Vehicle Safety Alliance

Website: cvsa.org/eventpage/events/cvsa-workshop/

The Commercial Vehicle Safety Alliance (CVSA) is a nonprofit association comprising local, state, provincial, territorial, and federal commercial motor vehicle safety officials and industry representatives. The Alliance seeks to "achieve uniformity, compatibility and reciprocity of commercial motor vehicle inspections and enforcement by certified inspectors dedicated to driver and vehicle safety." CVSA oversees several programs aimed at educating inspectors and improving the safety of commercial vehicles in areas such as air brake effectiveness and unsafe driving behaviors.

International Road Federation Global

Website: www.irf.global

The International Road Federation (IRF) is an international non-profit group based in Washington, D.C. IRF assists countries in "progressing towards better, safer and smarter road systems" by developing and delivering knowledge resources, advocacy services, and continuing education programs. Its Global Training Curriculum provides technical expertise in classroom and practical settings where attendees learn from and have direct access to seasoned professionals.

Tribal Safety

Website: tribalsafety.org

The tribalsafety.org website represents an online clearinghouse for practitioners that was developed by the Alaska Tribal Technical Assistance Program (TTAP) in partnership with participating Tribes, federal and state partners, and TTAP Centers. Although the Tribal Transportation Safety Management System Steering Committee uses the site to share information with members, a variety of resources, ranging in topics from safety planning and data to impaired driving and roadway departure, are provided to the public. Links to archived webinars and regional safety summits are also shared.

Safety Fest Boise

Website: safetyfest-boise.org

Safety Fest is an example of an annual regional event that provides free safety and health training to workers, supervisors, and managers. The event enables many of the Pacific Northwest's "frontline workers" to learn methods to reduce hazards that can cause workplace fatalities, injuries, and illnesses. Attendee topics range from construction to general industry to mine safety and health.

2.1.4. University-Affiliated Organizations

University of Maryland

Website: www.citeconsortium.org

The Consortium for Innovative Transportation Education (CITE) was established in 1998 to provide "transportation engineering students and professionals with an integrated curriculum covering the technologies and management subjects associated with Intelligent Transportation Systems (ITS)." The curriculum broadly focuses on information technology, transportation engineering, project management, performance management, systems engineering, and ITS technology. CITE offers training in three different formats: blended (instructor-led), self-paced (independent study), and full semester.

Portland State University

Website: nitc.trec.pdx.edu

The National Institute for Transportation and Communities (NITC) is currently one of five United States Department of Transportation (USDOT) national university transportation centers (UTCs). As a national UTC, NITC hosts frequent online webinars that are archived on its website and available for any user to view for free. These webinars cover a wide variety of transportation topics, including shared streets and bicycle / pedestrian accessibility and safety; its existing archive features over 500 such resources.

University of Minnesota

Website: www.roadwaysafety.umn.edu

The Roadway Safety Institute is a regional university transportation center that "conducts activities to advance domestic technology and expertise in the many disciplines that make up transportation through education, research, and technology transfer activities at university-based centers of excellence." RSI activities focus on user-centered transportation safety systems with an overarching goal of preventing crashes to reduce fatalities and life-changing injuries. Its research incorporates both engineering and social sciences, and a majority of RSI's seminars incorporate some type of safety topic.

Rutgers University

Website: cait.rutgers.edu

The Center for Advanced Infrastructure and Transportation (CAIT) is another national university transportation center and hosts periodic courses on transportation topics such as asphalt design, traffic regulations, and bridge maintenance. CAIT activities seek to advance the "safe, efficient, economical, and environmentally sound movement of people and goods in our nation and beyond," with the majority of its work focusing on the USDOT strategic areas of state of good repair, economic competitiveness, and safety.

Montana State University

Website: chsculture.org

The Center for Health and Safety Culture (CHSC), which is part of the Western Transportation Institute at Montana State University, is an "interdisciplinary center serving communities and organizations through research, training, and support services to cultivate healthy and safe cultures. The Center is dedicated to applying research to develop sustainable solutions to complex social problems, and its research focuses on understanding how culture impacts behavior—especially behavior associated with health and safety." Current research projects include addressing substance abuse, traffic safety, child maltreatment, and violence. CHSC holds an annual symposium on how a positive culture can help promote a healthy society.

2.1.5. Other Entities

Lifesavers Conference

Website: lifesaversconference.org

The annual Lifesavers Conference represents "the largest gathering of highway safety professionals in the United States" and "brings together a unique combination of public health and safety professionals, researchers, advocates, practitioners and students committed to sharing best practices, research, and policy initiatives that are proven to work." The Conference covers a wide variety of transportation safety topics, including distracted motorists and pedestrians, drugged driving, driving under the influence, and autonomous vehicles.

360training.com

Website: www.360training.com/environmental-health-safety/transportation-safety-training

360training.com has developed and offers a safety training course for drivers of large trucks and buses and a similar course for drivers of cars, vans, and small trucks. 360training.com's courses are aimed at companies that buy the training in a package for multiple employees. In addition to driver safety training, 360training.com offers a DOT supervisor training course on how to determine whether employees are sufficiently exhibiting safe behavior while operating vehicles.

National Safety Compliance

Website: www.osha-safety-training.net

National Safety Compliance offers a wide variety of safety-related training. Although its primary focus area is related to Occupational Safety and Health Administration (OSHA) compliance, some of its training

resources and materials (i.e., accident investigation, driving safety, powered industrial trucks) tangentially relate to transportation safety.

OHSA.com Transportation Safety Courses

Website: www.osha.com/courses/transportation.html

OHSA.com offers online OSHA training (and on-demand training) that is tailored for drivers or employees. Its transportation safety training programs are created for safety managers, safety trainers, construction employees, employees who deal with safety hazards or environmental hazards, and general workforce employees. They are designed "for drivers to improve their driving skills and learn the rules and laws when on the road." These courses target commercial vehicle drivers to "enhance their skills and make them sharper and more aware when on the road."

IMPROV

Website: www.myimprov.com

Interactive Education Concepts (IEC), under the trade name Traffic School by Improv, Improv Traffic School, and Driver License Direct by Improv, has been providing behavior-based driver education, traffic school, and defensive driving programs to students for 20 years. Improv has "won numerous awards from the media and other organizations over the years for its unique curriculum that is written by professional Hollywood writers and based on humor." As an example, Improv offers an Idaho-approved, 30-minute defensive driving course for $28.

CED Engineering

Website: www.cedengineering.com

Continuing Education and Development, Inc. (CED) provides "online engineering continuing education courses, video presentations and live webinars to licensed professional engineers to enhance their engineering knowledge and competence as well as to assist them in fulfilling their Continuing Professional Competency (CPC) requirements by earning their Professional Development Hour (PDH) and Continuing Education Unit (CEU) credits mandated by their respective state licensing boards." CED offers a large selection of transportation engineering courses featuring topics such as bicycle planning and safety and identifying optimum intersection lane configuration and signal phasing.

Center for Transportation Safety

Website: centerfortransportationsafety.com

The Center for Transportation Safety (CTS) is part of Driving Dynamics, Inc. Driving Dynamics is a "leading provider of advanced performance driver safety training and fleet risk management services throughout North America." CTS offers behind-the-wheel driver education, simulator-based training, online learning, and driver risk management to help fleet-based organizations reduce potential crash rates.

2.2. Current Offerings

To capture the breadth of transportation and traffic safety-related offerings actively available to practitioners and members of the general public, a snapshot of current offerings was compiled during the last two weeks of January 2018. Course offerings were compiled by topic, host organization, format,

length, and cost, based on available information. An abbreviated summary, alphabetized by offering title, is shown in Figure 2-1, Figure 2-2, and Figure 2-2.

TOPIC	HOST	FORMAT	LENGTH	COST
Access Management	CED Engineering	online course		$96
Accessible Approach to Shared Streets	National Institute for Transportation & Communities	Online Webinar	60 minutes	free
Achieving Safety Results by Addressing Behavioral Issues	National Center for Rural Road Safety	webinar	90 minutes	free
Adaptive Traffic Control Systems as a Way to Measure Performance of Arterial Streets	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Aircraft Accident Investigation	National Transportation Safety Board (NTSB)		12 days	$3,970; $4,070 Late
Aircraft Accident Investigation for Aviation Professionals	National Transportation Safety Board (NTSB)		2 days	$1034 Early, $1134 Late
Application of Clear Zones for Roadway Departures	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Are Autonomous Vehicles Safe? What's Already Here & What Needs to Happen	Intelligent Transportation Systems (USDOT)	Online Webinar	60 minutes	free
Automated Driving	Institute of Transportation Engineers	Online Podcast	31 minutes	free
Avoiding Roundabout Design Failures	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Basic Road Work Safety- Temporary Traffic Control	Minnesota DOT	online tutorial		free
Basic Rotorcraft Accident Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	56 hours	$2,854
Bike Planning and Safety	CED Engineering	online course		$96
Biochemechanics of High Impact Injury	National Transportation Safety Board (NTSB)			TBD
Cargo/Tank Truck Rollover Prevention	Federal Motor Carrier Safety Administration	Online Video	17 minutes	free
Child Safety Restrain Systems on School Buses	NHTSA	Online Video Series	27 minutes	free
Cognitive Interviewing Series	National Transportation Safety Board (NTSB)		2 days	$1034 Early, $1134 Late
Collaborating with Law Enforcement to Reach Zero	National Center for Rural Road Safety	webinar	90 minutes	free
Complete Streets	ATSSA	live webinar	30 minutes	free for members
Conversation with Sam Schwartz: Future of Transportation	Institute of Transportation Engineers	Online Podcast	26 minutes	free
Countermeasures for reducing collisions at Pedestrian Crossings	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Crash Risk Factors for Low-Volume Roads:an ODOT Case Study	National Center for Rural Road Safety	webinar	90 minutes	free
Critical Aspects of Timing Traffic Signals to Maximiize Road User Safety	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
CSA Driver Compliance	OHSA.com	online video	5 hours	79
CVSA Workshop: Commercial Vehicle Safety	Commercial Vehicle Safety Alliance	In-Person Conference	5 days	$550-$750
Defensive Driving/Driving Safety	National Safety Council	Online Webinar OR In Person	20-240 minutes	$25-$41
Defining the Future for Safe Rural Transportation in Rural America	National Center for Rural Road Safety	webinar	90 minutes	free
Designing In-Vehicle Systems for High-Risk Drivers for Teens and Older Drivers	Roadway Safety Institute	Online Webinar	57 minutes	free
Designing Safer Roads for Pedestrians and Bicyclists	UF	live webinar	8 hours	Public 125, Private 175
Driver Safety Course for Cars, Vans & Small Trucks	OHSA.com	online	6 hours	220
Driver Safety Course for Large Trucks and Buses	OHSA.com	online	4 hours	160
Driver Safety Resources for Drivers	Federal Motor Carrier Safety Administration	Website		free
Driving Safety Game	National Safety Compliance	DVD disc		129
Effectively Managing Transit Emergencies	Transportation Safety Institute (USDOT)	In-Person Seminar Series	29.5 hours	$60
Effects of Traffic Calming Measures on Pedestrians and Motorists	CED Engineering	online course		$48
Engineering Countermeasures to Reduce Red-Light Running	CED Engineering	online course		$168
Engineering Treatments and Design Development Strategies for Creating Safe Routes to Schools	ASCE	webinar	60 minutes	M99, NM 129; Group M199 NM 299
Enhanced work zone safety and reliability through connected automation technologies	National Operations Center of Excellence	webinar		free
Examination of Supplemental Driver Training & Online Basic Driver Education	NHTSA	Online PDF	152 pages	free
FHWA Road Safety Audit Guidelines	National Highway Institute	online document		free
FHWA Safety Data & Analysis Toolbox	National Center for Rural Road Safety	webinar	90 minutes	free
FHWA Speed Management ePrimer for Rural Transition Zones & Town Centers	Institute of Transportation Engineers	Online Webinar	90 minutes	free
Finding the Right Tool for the Job – A Safety Data and Analysis Toolbox	Institute of Transportation Engineers	Online Webinar	90 minutes	$49 M; $99 NM
Fundamentals of Bus Collision Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	38 hours	$85
General Hazardous Materials Inspection	Federal Motor Carrier Safety Administration	In-Person Course	5 days	
Helicopter Accident Investigation	National Transportation Safety Board (NTSB)		5 days	$2100 Early, $2200 Late
High and Street Safety On-Demand Webinar Package	ASCE	webinar package	16 hours	M 540, NM 740
Highway Crash Investigation	National Transportation Safety Board (NTSB)		8.5 hours	$250 Early, $350 Late
Highway Safety Data Systems	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Highway Safety Features	UF	online video	3 hours	free
Highway Safety Priorities	Lifesavers Conference	In-Person Conference	3 days	$350-$500 ($100 Students)
How to Address Rpadwau Safety Issues for ATVs and Other Off-Road Vehicles	National Center for Rural Road Safety	webinar	90 minutes	free
Idaho Approved Defensive Driving Course	IMPROV Safety	online	30 minutes	27.95
Impaired Driving Law Enforcement Training	NHTSA	In-Person Course	1-5 days	
Implementing Connected Vehicle Technology and Strategies	Institute of Transportation Engineers	Online Webinar	90 minutes	free

Figure 2-1 Review list of transportation-related training opportunities (part I)

TOPIC	HOST	FORMAT	LENGTH	COST
Improving Highway Safety with ITS	CITE	online course	8 hours	$250
Improving Highway Safety: An Overview of 9 Proven Crash Countermeasures	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Improving the Safety of Railroad Crossings & Light Rail Systems	Tech Transfer	live online	4 hours	CA Public 145, Others 290
Incoporating Safety Data into the Planning Process at the Rural Level	National Center for Rural Road Safety	webinar	90 minutes	free
Increasing Freeway Capacity by Using Safety Lanes as Travel Lanes	CED Engineering	online course		$168
Instructor Development (Traffic Safety)	NHTSA	In-Person Seminar Series	38.5 hours	$0
Instructors Course for Transit Trainers	Transportation Safety Institute (USDOT)	In-Person Seminar Series	40 hours	$140
Intermodal Accident Site Photography	National Transportation Safety Board (NTSB)		3 days	$1198 Early, $1248 Late
Intersection Safety	CED Engineering	online course		$96
Investigating Human Fatigue Factors	National Transportation Safety Board (NTSB)		2 days	$1034 Early, $1134 Late
Investigative Safety Analysis	Federal Motor Carrier Safety Administration	In-Person Course	12 days	
ITE Vision Zero Virtual Toolbox	National Center for Rural Road Safety	webinar	90 minutes	free
Lagging Left-Turn Arrow Safety and Operation	Institute of Transportation Engineers	Online Webinar	90 minutes	$149 M; $199 NM
Large Truck and Bus Traffic Enforcemen	Federal Motor Carrier Safety Administration	Online Videos, PDF's	2 hours	
Law Enforcement & Commercial Driver Training	Federal Motor Carrier Safety Administration			
Linking Safety and Operations	National Operations Center of Excellence	photo/video		free
Low Cost Treatments for Horizontal Curve Safety	CED Engineering	online course		$96
Managing Communications During an Aircraft Accident or Incident	National Transportation Safety Board (NTSB)		2 days	$1034 Early, $1134 Late
Managing Communications Following a Major Transportation Accident	National Transportation Safety Board (NTSB)			
Managing Pedestrian Safety Programs	NHTSA	In-Person Course	2 days	
Managing Speed: Self-Enforcing Roadway Concepts	Institute of Transportation Engineers	Online Webinar	90 minutes	$49 M; $99 NM
Marine Accident Investigation	National Transportation Safety Board (NTSB)			TBD
Modern Transportation Tech, Autonomous Vehicles, Electrification	ITS Detroit	In-Person Conference	4 days	
Moving People - Steady, Slower, Smarter, and Safer	Institute of Transportation Engineers	On-Demand Recording	90 minutes	$49 M; $99 NM
New Entrant Safety Audit Course	Federal Motor Carrier Safety Administration	In-Person Course	12 days	
North American Standard Commercial Vehicle Inspection	Federal Motor Carrier Safety Administration	In-Person Course	5 days	
Orientation to Work Zone Safety	U of Minnesota	online tutorial		free
Passenger Vehicle Inspection	Federal Motor Carrier Safety Administration	In-Person Course	3 days	
Pedestrian and Bicycle Safety Assessment Studies	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Pedestrian and Bicyclist Safety and Mobility	CED Engineering	online course		$120
Pedestrian Safety	CED Engineering	online course		$96
Pedestrian Treatments for Uncontrolled Locations	National Center for Rural Road Safety	webinar	90 minutes	free
Pilot/Escort Vehicle Operators Best Practices Guidelines	Federal Highway Administration (FHA)	Online Document		free
Prevent Accidents and Traffic Delays, by Improving Signal Timing	ASCE	live webinar	60 minutes	M99, NM 129; Group M199 NM 299
Preventing Wrong-Way Driving on Freeways	CED Engineering	online course		$144
Primer on the Joint Use of the HSM and the HFG for Road Systems	National Center for Rural Road Safety	Online Webinar	90 minutes	free
Promoting Bicycle Commuter Safety	CED Engineering	online course		$216
Protected Bikeway Design: a 6-Part Series	Institute of Transportation Engineers	Online Webinar	90 minutes	$149 M; $199 NM
Proven Safety Countermeasures Webinar	Tribal Safety	Online Webinar		
Public Health Perspective to Rural Transportation Safety	National Center for Rural Road Safety	webinar	90 minutes	free
Rail Accident Investigation Orientation	National Transportation Safety Board (NTSB)		2 days	$1034 Early, $1134 Late
Reducing Collisons at High Crash Locations	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Reducing Safety at Railroad Highway Grade Crossings	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Relationship Between Public Perceptions of Speed, Speed Laws, and Safety	Roadway Safety Institute	Online Webinar	60 minutes	free
Road Safety Adits: Case Studies	National Highway Institute	online document		free
Road Safety and Signage Audit: Proactive Roadway Safety in 21st Century	ASCE	live webinar	60 minutes	M99, NM 129; Group M199 NM 299
Road to Zero Coalition	Institute of Transportation Engineers	Online Podcast	29 minutes	free
Roadway Geometric Design for Improved Safety and Operations	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Safe Transportation for Every Pedestrian (STEP)	UVA Transportation Training Academy	In-Person Course	6.8 Hours	$75-$300
Safe, Multimodal, Integrated Transportation Services	Institute of Transportation Engineers	Online Podcast	24 minutes	free
Safer Roads by Design: Road Safety Audit	International Road Federation (IRF) Global	In-Person Conference	3 days	$1,500 Member, $2,000 Regular
Safety and Health training for Workers, Supervisors, and Managers	Safety Fest of the Great Northwest Boise	In-Person Courses	4 days	
Safety Effects of Roadway Design	UVA Transportation Training Academy	In-Person Course	6.8 Hours	$75-$300
Safety Fundamentals: A 9-Part ITE Learning Hub Webinar Series	Institute of Transportation Engineers	Online Webinar Series	90 minutes	$99 M; $149 NM
Safety Toolkit for Improving Roads and Intersection	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349

Figure 2-2 Review list of transportation-related training opportunities (part II)

TOPIC	HOST	FORMAT	LENGTH	COST
School Bus Driver In-Service Safety Series	NHTSA	Online PDF and Misc. Docs		free
School Zones: A Comprehensive Looks, Markings, and Safety Programs	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Setting and Managing Speed Zones	ASCE	webinar	90 minutes	M99, NM 159; Group M249 NM 349
Seven Steps for Safety at Highway-Rail Grade Crossings	Federal Motor Carrier Safety Administration	Online Brochure		free
Shared Mobility	Institute of Transportation Engineers	Online Podcast	25 minutes	free
Shoulder Treatments: Rumble Strips	CED Engineering	online course		$72
Sight Distance	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
SMS Principles for Transit	Transportation Safety Institute (USDOT)	In-Person Seminar Series	21 hours	$55
Survival Factors in Aviation Accidents	National Transportation Safety Board (NTSB)			TBD
The Culture of Swedish Vision Zero	National Center for Rural Road Safety	webinar	90 minutes	free
The Next Step in Auto Safety: Vehicle to Vehicle Communications	CED Engineering	online course		$96
Toolbox of Countermeasures & their Potential Effectiveness for Intersection Crashes	National Highway Institute	online document		free
Toolbox of Countermeasures & their Potential Effectiveness for Pedestrian Crashes	National Highway Institute	online document		free
Toolbox of Countermeasures & their Potential Effectiveness for Roadway Crashes	National Highway Institute	online document		free
Toward Minimalistic and Learning-Enabled Autonomous Navigation	Roadway Safety Institute	Online Webinar	59 minutes	free
Toward Vision Zero: Tools and Tips for Achieving Target Speeds in Your Community	Institute of Transportation Engineers	Online Webinar	90 minutes	$49 M; $99 NM
Toward Zero Deaths- Proactive Steps for Your Community	National Center for Rural Road Safety	webinar	90 minutes	free
Toward Zero Deaths through Improved Transportation Systems Management and Operations	National Center for Rural Road Safety	webinar	90 minutes	free
Traffic Calming	Center for Advanced Infrastructure & Transportation	In-Person Conference	7 hours	free
Traffic Calming	UVA Transportation Training Academy	In-Person Course	6.8 Hours	$75-$300
Traffic Calming: The Lumps and the Bumps	ASCE	live webinar	90 minutes	M99, NM 159; Group M249 NM 349
Traffic Occupant Protection Strategies, Seat Belts Use and Enforcement	Transportation Safety Institute (USDOT)	Online E-Learning Course	8.5 hours	
Traffic Safety, Substance Abuse, other misc. topics	Center for Health & Safety Culture	In-Person Conference	2.5 days	$675
Transit Rail Incident Investigation	Transportation Safety Institute (USDOT)	In-Person Seminar Series	33 hours	$95
Unpaved Road Safety	National Center for Rural Road Safety	webinar	90 minutes	free
usRAP: An Innovation in Data Driven Safety Analysis	National Center for Rural Road Safety	webinar	90 minutes	free
Vision Zero for All Users: Lessons Learned and New Strategies	Institute of Transportation Engineers	Online Webinar	90 minutes	$149 M; $199 NM
Vision Zero in Sweden	Institute of Transportation Engineers	Online Podcast	22 minutes	free
What Legal Professionals Need to Know in Transportation Accident Investigation	National Transportation Safety Board (NTSB)			TBD
Work Zone Safety Awareness Workshop	Center for Advanced Infrastructure & Transportation	In-Person Conference	5 hours	$95

Figure 2-3 Review list of transportation-related training opportunities (part III)

2.3 References

ASCE, 2018. Policy Statement 465 – Academic Prerequisites for Licensure and Professional Practice. ASCE. Accessed February 5, 2018. http://www.asce.org/issues-and-advocacy/public-policy/policy-statement-465---academic-prerequisites-for-licensure-and-professional-practice/.

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CHAPTER 3. PROFESSIONAL CONTINUING EDUCATION

The transportation sector is constantly evolving, driven by technological advancements, changing demographics, and increasing environmental concerns. To ensure a skilled and adaptable workforce that can navigate these complexities, the Workforce Development Institute (WDI) offers a comprehensive suite of professional development and educational programs. This chapter focuses on WDI's commitment to continuing education, highlighting our efforts to equip transportation professionals with the latest knowledge and skills.

We begin by exploring our diverse range of short courses designed to address the immediate training needs identified through close collaboration with local transportation agencies and companies. These courses delve into critical areas such as spatial analysis using GIS, transportation economics, freight logistics, and school zone safety.

Next, we delve into the unique considerations of adult learning. WDI recognizes that adult learners bring a wealth of experience to the classroom. This section discusses the research conducted by our team to identify and implement effective teaching strategies specifically tailored to adult learners.

Moreover, our commitment extends to nurturing the next generation of transportation professionals through education activities tailored for undergraduate and graduate students. By harnessing the collective strengths of partner universities in transportation research and education, we aim to instill a passion for innovation and excellence, laying the groundwork for future leaders in the field.

3.1 Workforce Development Short Courses

3.1.1 Spatial and Geographic Analysis: GIS for Transportation Professionals

The first short course developed is aimed at providing transportation professional hands-on skills training in geospatial and geographic information systems (GIS). This course can only be offered to students who have access to the ArcGIS software from ESRI, either on site at a computer lab or at individual workstations and attending training remotely. This short course was designed to be presented over one week, between 9:00 am and 4:00 pm, although modifications to this schedule could be incorporated. The outline and timing of topics covered are presented in figures 3-1 through 3-7. The course includes topics of creating maps, creating map symbology, query and map exporting, geocoding non-spatial data, joining attribute data from a variety of data sources, and buffer analysis. Once these geospatial skills have been introduced and described, the students apply the techniques by utilizing data from past projects aimed at solving transportation problems commonly faced by transportation analysts at state and regional transportation agencies. Advanced topics, depending on the audience progression and time availability, could include optimal routing, traveling salesman problems, network analysis, site selection, impedance analysis, and others.

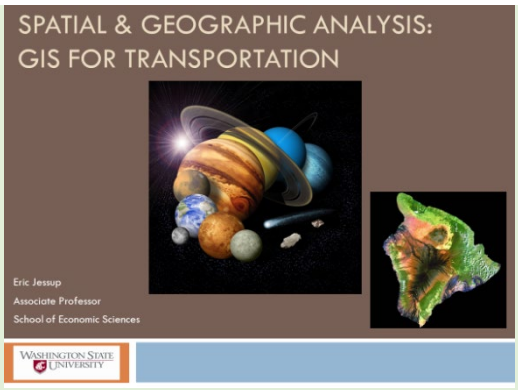

Figure 3-1 Introduction to Spatial and Geographic Analysis

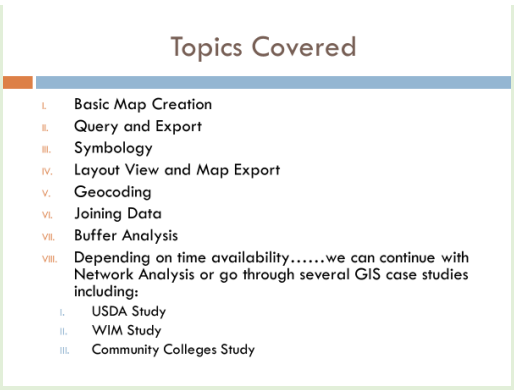

Figure 3-2 Topics covered: GIS for Transportation

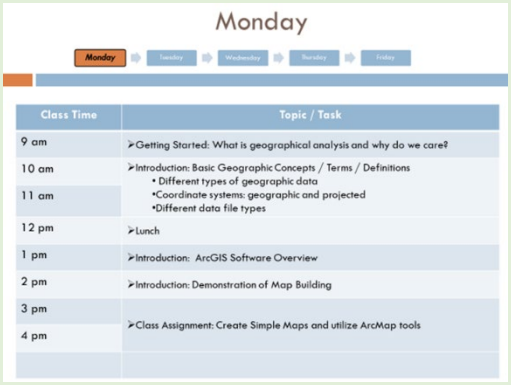

Figure 3-3 First day schedule: GIS for Transportation

Figure 3-4 Second day schedule: GIS for Transportation

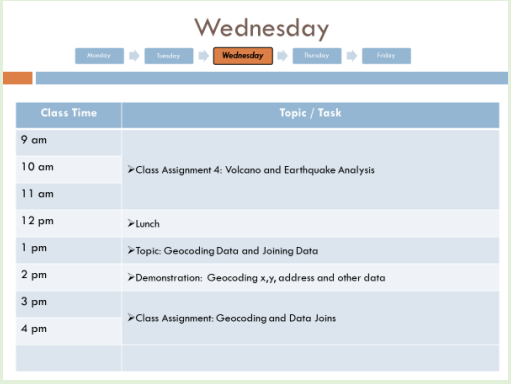

Figure 3-5 Third day schedule: GIS for Transportation

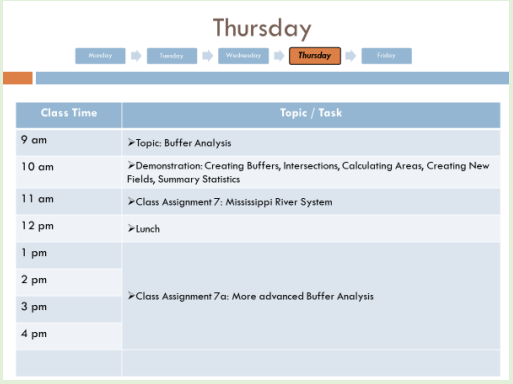

Figure 3-6 Fourth day schedule: GIS for Transportation

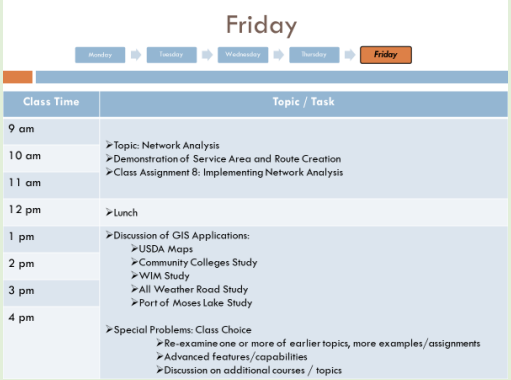

Figure 3-7 Fifth day schedule: GIS for Transportation

3.1.2 Transportation Economics and Public Infrastructure Funding

The second short course developed as part of the WDI focuses on the fundamentals of transportation economics and issues surrounding the funding of public transportation infrastructure. This one-week course is focused on transportation professionals in policy-oriented positions who wish to better understand the economic trade-offs between alternative investment scenarios, particularly related to public transportation infrastructure. In contrast, the spatial analysis course described earlier is more focused on data analyst professionals who seek to improve their capabilities in managing spatial data and solving transportation-related problems utilizing geospatial software. The course schedule for this second course is provided in figures 2-8 to 2-14 and covers the primary fundamental economics associated with public goods (transportation, particularly). The audience includes individual economic agents attempting to solve travel demand needs across a variety of modal alternatives, businesses wishing to solve their freight transportation demand for products shipped, and collectively agencies managing the transportation system and striving to achieve a variety of objectives (budget limitations, travel customers, safety, mobility, reliability, resiliency). This course includes detailed discussion regarding the evolution of publicly funded transportation infrastructure in the U.S. and how the condition of that infrastructure has changed over time and has been funded and maintained. This is particularly important given changes in vehicle and information technology. Lastly, the course spends time comparing alternative funding mechanisms for transportation systems of the future, including those being tested in several states (e.g., Oregon's mileage use tax).

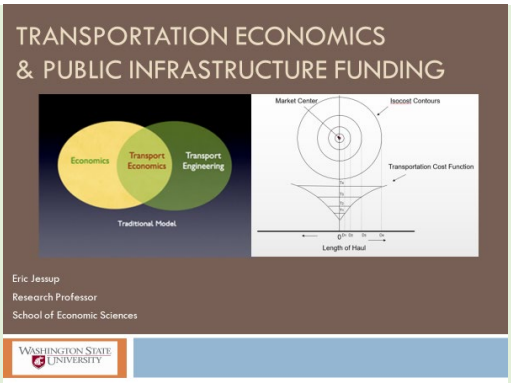

Figure 3-8 Introduction to Transportation Economics and Public Infrastructure Funding

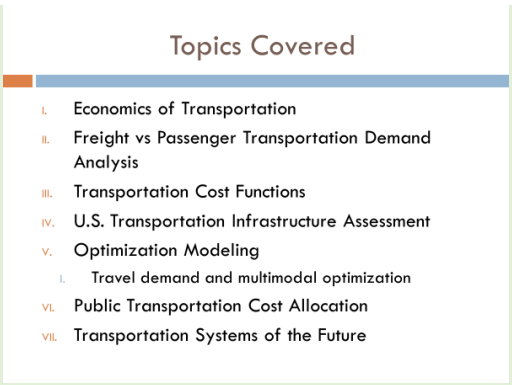

Figure 3-9 Topics covered: Transportation Economics

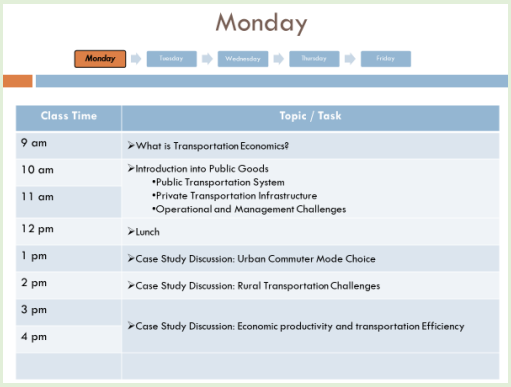

Figure 3-10 First day schedule: Transportation Economics

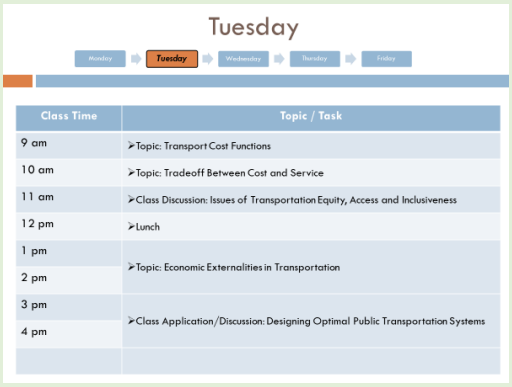

Figure 3-11 Second day schedule: Transportation Economics

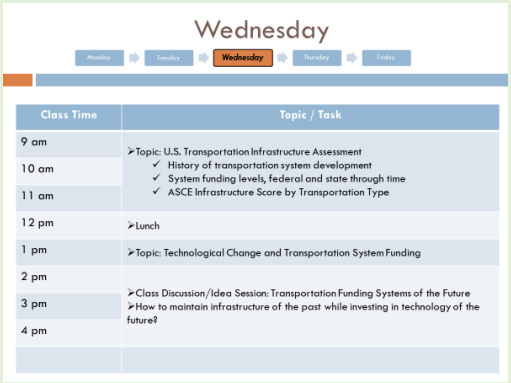

Figure 3-12 Third day schedule: Transportation Economics

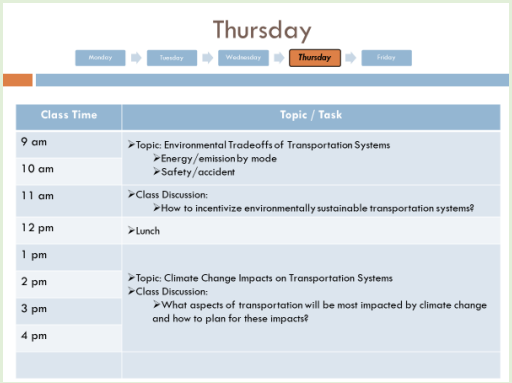

Figure 3-13 Fourth day schedule: Transportation Economics

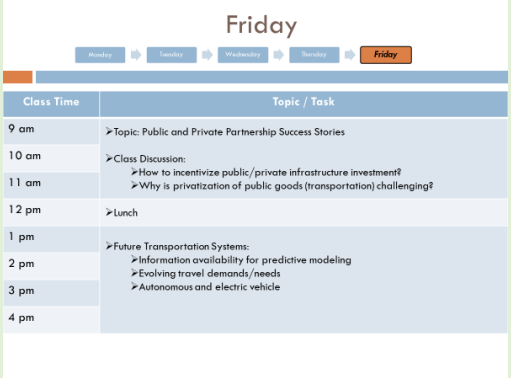

Figure 3-14 Fifth day schedule: Transportation Economics

3.1.3 Freight and Logistics Systems Analysis

The last of the three short courses developed focuses on freight transportation. The audience for this education opportunity extends to both public and private transportation professionals and may include regional/state/national transportation agencies, ports, and private firms involved in the movement of products. Given the diversity of the regional economy in the Pacific Northwest and the dependance on trade and export markets, the audience for this course should be large. The schedule for this one-week course is provided in figures 2-15 to 2-21. This course begins with an overview of the freight and logistics industry before providing a detailed description of each freight mode's attributes and industry characteristics. This analysis and description is from an economics rubric, including assessment of tradeoffs among cost, service, and energy efficiency. The key freight modes include truck, Class I rail, barge and inland water navigation, ocean freight, and pipeline. Air freight is not included in the course but could be included depending on audience fit and interest. Once each freight mode has been analyzed, one day is allocated to third party logistics providers and the economic value these companies represent. Lastly, the course covers the evolution of new technologies in the movement of freight and connected information systems to improve performance and efficiencies. These include innovations from freight companies such as Convoy and Flexport that have leveraged real-time information systems to eliminate many inefficiencies in freight activities (empty backhaul miles, shipment delays from traffic disruptions, equipment alignment, labor allocations). Unlike the previously described two short courses, this course weaves in knowledge and expertise from private sector guest speakers to maximize relevance and suitability.

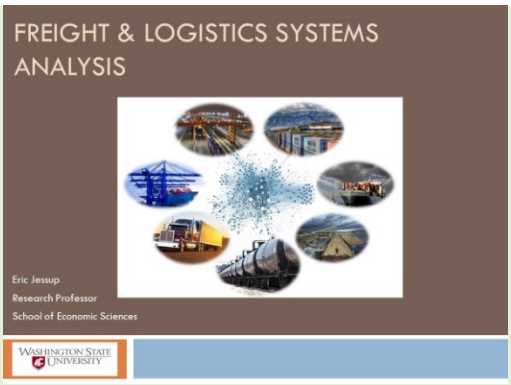

Figure 3-15 Introduction to Freight and Logistics Systems Analysis

Figure 3-16 Topics covered: Freight and Logistics

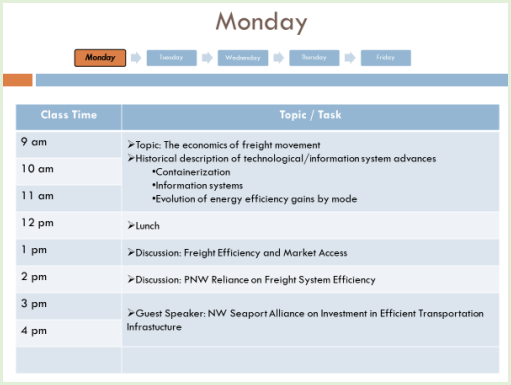

Figure 3-17 First day schedule: Freight and Logistics

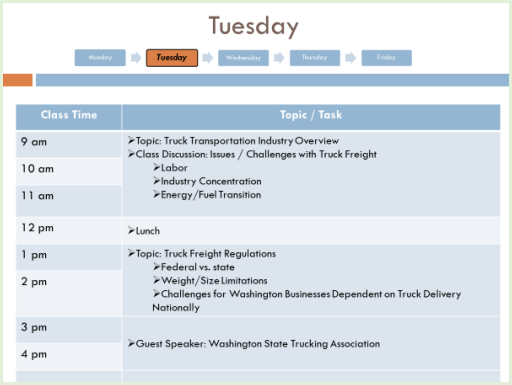

Figure 3-18 Second day schedule: Freight and Logistics

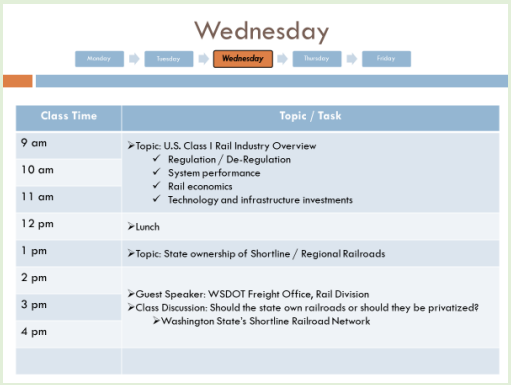

Figure 3-19 Third day schedule: Freight and Logistics

Figure 3-20 Fourth day schedule: Freight and Logistics

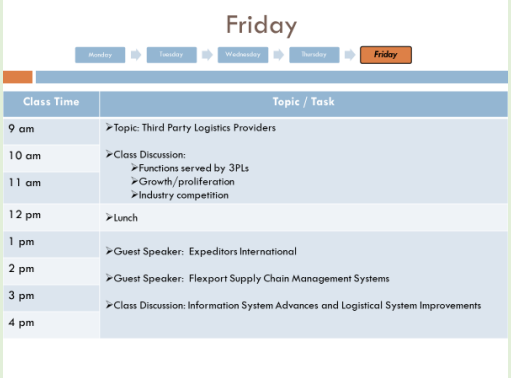

Figure 3-21 Fifth day schedule: Freight and Logistics

3.1.4 An Introduction to School Zone Safety

The University of Idaho team identified the potential topics of pedestrian safety and school safety, and a decision was ultimately made to prioritize the school safety course offering.

Outreach Activities

Two recruitment videos, focused on the school safety course, were developed in May 2021. The first version (1 minute, 31 seconds) included narration, whereas the second video (38 seconds) only provided background music and was slightly shorter in length. The slides used for the video are shown as Figure 3-22. The format and color scheme for the slide background were also determined as a group by mutual consensus.

Figure 3-22 Content for Pactrans WDI recruitment videos

In June 2021, a final draft outline of the school safety training was developed. The draft included specific information such as the course title, course description, learning objectives, content outline, and course length. The baseline handout containing this information is provided as Figure 3-23.

Course Title

An Introduction to School Zone Safety

Description

This PacTrans Workforce Development Institute training opportunity will introduce you to all aspects of safety in school zones. The content will benefit you if you are a professional who manages, provides consulting for, or is considering a school zone safety program in your community.

The training will begin with an overview of school zone safety. This discussion will be followed by an explanation of the current guidelines in the Manual on Uniform Traffic Control Devices, or MUTCD, to help you identify whether the current practices in your city, town, or jurisdiction are in compliance. Case studies and specific examples will be provided to help you understand why different treatments apply to different conditions. The training will conclude with a discussion on the Safe Routes to School Program and the important guidance that you can provide to your community to foster an environment that promotes safety for both the motoring and non-motoring public near your neighborhood schools.

Learning Objectives

Participants will learn about:

- Existing Manual on Uniform Traffic Control Devices (MUTCD) guidelines
- Different school zone speed assembly options and the pros and cons of each
- Specific solutions or treatments to improve school zone safety in local communities
- School zone safety and the correlation between travel behavior and student health
- Success stories implemented by other jurisdictions throughout the country

Content Outline

- Introduction
- The Importance of School Zone Safety
- School Safety in the MUTCD
- Signage Enhancements
- Safe Routes to School Programs
- Conclusions / Training Takeaways

Software Requirements

None

Length

3 hours, presented as (2) 90-minute modules

Figure 3-23 Course description for school safety training

During Summer 2021, the PacTrans team continued to meet to discuss the logistics of the training and to finalize the date and time. In September 2021, the advertising flyer for the training was finalized (see Figure 3-24), and this document was broadly shared by PacTrans and posted on LinkedIn.

-PacTrans Workforce Development Institute-

AN INTRODUCTION TO SCHOOL ZONE SAFETY

October 19th, 2021 and October 20th, 2021 (12:30 pm to 2:30 pm Pacific Time) via Zoom webinar

Course Description: This PacTrans Workforce Development Institute training opportunity will introduce you to all aspects of safety in school zones. The content will benefit you if you are a professional who manages, provides consulting for, or is considering a school zone safety program in your community. The training will begin with an overview of school zone safety. This discussion will be followed by an explanation of the current guidelines in the Manual on Uniform Traffic Control Devices, or MUTCD, to help you identify whether the current practices in your city, town, or jurisdiction are in compliance. Case studies and specific examples will be provided to help you understand why different treatments apply to different conditions. The training will conclude with a discussion on the Safe Routes to School Program and the important guidance that you can provide to your community to foster an environment that promotes safety for both the motoring and non-motoring public near your neighborhood schools.

Registration Link: https://pactranswdi.org/iszs. The registration fee for the webinar is $200. Please register for the course by 10/14/2021. For assistance, please contact the PacTrans WDI by email: contacts@pactranswdi.org.

Course Credit: 4 Professional Development Hours (PDH). Please reference your state's PDH protocol. Certificate of completion will be provided after the training.

Instructor: Kevin Chang, PH.D., P.E., Associate Professor in Civil & Environmental Engineering at the University of Idaho. Kevin has over 15 years of experience in the areas of project management and design; traffic safety and operations; and transportation planning. Prior to his current position, Kevin was a traffic engineer with the King County Department of Transportation in Seattle, Washington, where he supervised and managed neighborhood transportation plans, the implementation of livable communities, pedestrian and school safety programs, and numerous non-motorized projects. Kevin is registered as a Professional Engineer in Washington and California, has taught coursework at the University of Washington and the University of Idaho, and has published and presented at national and international conferences. Kevin is a Past President for the Washington State Section of ITE, Chair of the TRB School Transportation Subcommittee, and a certified Safe Routes to School National Course Instructor. In his spare time, Kevin has been a strong advocate for civic engagement and has volunteered his time by serving as a board member for several non-profit community organizations.

WORKFORCE DEVELOPMENT INSTITUTE
PACTRANS
REGION 10

Oregon State University
University of Idaho
UNIVERSITY of WASHINGTON
UNIVERSITY OF ALASKA FAIRBANKS
BOISE STATE UNIVERSITY
GONZAGA

PacTrans-WDI
More Hall 112, The University of Washington
Seattle, WA, 98195-27000
Email: contacts@pactranswdi.org
Tel:+1 (206)685-0395

Figure 3-24 Course description for school safety training

On October 11, 2021, the University of Idaho team was informed that this initial offering would be postponed, due in part to low registration and because PacTrans advertising efforts had been "mostly used toward the PacTrans conference."

At the time, a decision was made to advertise the course after the 2021 PacTrans conference, with suggested dates in November and December 2021. On the basis of potential conflicts due to the holiday

season and the annual Transportation Research Board conference in January, the course was then postponed twice, first in January 2022 and then in March/April 2022. At present, the course remains an active offering through the PacTrans WDI.

Our team from the University of Idaho was able to utilize some of the content built for this course to support two conference presentations regarding school transportation, first at the 2022 ASCE International Conference on Transportation and Development in Seattle, Washington, and then in 2023 at the PacTrans Regional Transportation Conference, also in Seattle.

In addition, our team offered three management courses three times to Alaska DOT&PF. Introduction to project management, Introduction to Construction Management, Introduction to Management of Design Projects. Each class accommodated 15 people and included 40 hours of training over three weeks. These courses were tailored to the needs of Alaska DOT&PF. We also developed the framework for continuing management education focused on career development.

3.2 Adult Learning

Adult learning principles, as theorized by Malcolm Knowles, highlight the self-directed nature of adult education. Knowles (1970) identified six characteristics of adult learners, emphasizing a cooperative learning climate and the drive for change in skills, behavior, knowledge, or attitudes. Adults differ from younger learners in their motivation, experience, engagement level, and application of learning (Knowles, 1970). They are most receptive when learning is connected to real-life experiences or challenges, and it is crucial to assess their readiness to learn for effective teaching (Knowles, 1970; O'Brien, 2004; Zemke and Zemke, 1995). E-learning for working adults has become a prominent medium, valued for its flexibility and efficiency. However, challenges in engaging users persist. Adult learners require content that aligns with their unique learning principles and objectives. Engagement in e-learning is crucial for effectiveness, yet there is a gap in understanding user needs and expectations, leading to less effective online learning experiences (Abu Bakar et al., 2015).

The concept of continuing professional development (CPD) plays a pivotal role in the professional landscape. In an era marked by rapid technological advancements and a significant shift toward online learning, CPD has become more than just a requirement; it is a cornerstone for professional growth and adaptability. CPD involves structured activities designed to enhance an individual's expertise, knowledge, and skills beyond their initial training. This continuous learning process is integral for professionals looking to stay relevant and competitive in a dynamic and evolving industry (Crawford and Irving, 2009). One of the primary benefits of CPD is the continuous enhancement of knowledge and skills. By engaging in CPD activities, professionals can acquire new insights, learn about emerging trends, and develop skills that are critical to their field. This is especially important in the transportation engineering sector, in which new technologies, methodologies, and practices are continually emerging. CPD ensures that professionals are well-equipped with the latest advancements, enabling them to adapt to and thrive in a rapidly changing environment. Additionally, CPD plays a vital role in career progression. Active engagement in CPD demonstrates a commitment to personal and professional development, making professionals more attractive to potential employers and opening doors to new career opportunities.

In online collaborative learning, understanding adult learner engagement is vital. Adults face various challenges, such as busy schedules and multiple societal roles, that impact their learning practice.

There's a need for more research on adult learning engagement in online environments, focusing on the characteristics of adult learners and how these influence learning outcomes (Abedini et al., 2017).

We describe two efforts below. The first focuses on understanding the implementation of active learning strategies. Our approach included conducting in-depth qualitative studies, in which we engaged with instructors from PacTrans professional development courses. Through inductive interviews, we explored how active learning, crucial for self-directed adult learners, could be integrated into these courses using an andragogical approach. We identified crucial constructs that they deemed important for integrating active learning in professional development courses. These findings led to the development of a scale to measure key constructs in adult learning and engagement. The survey's purpose was to measure work-related experience and engagement of adult learners in CPD courses. This approach allowed us to align our course design with the real-world needs and preferences of adult learners, thereby increasing the potential to enhance the effectiveness of the CPD courses. The initial steps of scale development are complete, but the questions still need to be asked of about 200 participants, and statistical analysis should be done to examine the reliability of the scale and the constructs within the scale.

3.2.1 Qualitative Study: How and Why Do Professional Development Instructors Implement Activities to Increase Learning Engagement in Their Classrooms?

We published a conference paper at the 2022 American Society for Engineering Education conference (Yaghoubisharif et al, 2022). Work leading to this conference paper resulted in an early understanding of how two CPD teachers incorporated active and adult learning strategies in their courses. Below, we have included a summary of the learning activities reported in the paper that the instructors believed to be impactful in their courses and resulted from our findings.

Constructs

1. **Payoff Expectation**: Adult learners in professional development courses are typically motivated by the direct benefits they expect to gain from the course. The instructors designed the courses with a clear focus on how the content would provide tangible benefits to the learners in their professional lives. This pragmatic approach to course design acknowledges and leverages the intrinsic motivation of adult learners seeking immediate and practical applications of their learning. *"I am more often talking to professionals who have been around for a while. Very often, what I'm trying to do, is to communicate to them about the applications of the course content."* This reflects the emphasis on direct applicability and relevance of the course material.
2. **Life-Centered Experience**: The instructor's strategy of incorporating life-centered experiences into the course content is particularly significant in adult education. Learning through real-world situations and practical applications makes the educational experience more relevant and impactful for adult learners, who bring a wealth of personal and professional experiences to the learning environment. This approach not only enhances engagement but also ensures that the learning is directly applicable to the learners' professional roles. One instructor noted, *"But that instruction is not complete until they've had an opportunity to think through it themselves in a real-world situation."* This quote underlines the importance of practical, real-life applications in adult learning
3. **Visualization Technologies in Active Learning**: This emphasizes the role of visualization technologies in enhancing engagement, especially in online learning environments. By

integrating videos and interactive visuals, the instructor bridges the gap between theoretical concepts and real-world applications, facilitating a deeper understanding and connection with the course material. *"Workforce development courses are through the use of video examples... But that instruction is not complete until they've had an opportunity to think through it themselves in a real-world situation."* This highlights the integration of technology to bridge theory and practice.

4. **Self-Directedness, Collaborative Learning, and Project-Based Activities:** In the context of adult education, particularly in professional development, self-directedness plays a crucial role. This project highlights this by focusing on how adult learners, with their diverse professional backgrounds, actively participate in shaping their learning journey. They contribute to choosing course outlines and additional topics, fostering an environment in which learners are not just passive recipients of information but active participants in their educational experience. This approach aligns with the understanding that adult learners prefer and benefit from a degree of control over their learning process. One instructor emphasized the role of self-directedness in adult education, allowing learners to have a say in their learning journey. As the instructor mentioned, *"I wanted to find out what the strengths of the team were and how my team wanted to accomplish that, and what they thought would be the timing. And generally, they were pretty close to the target."*
   The instructor's use of collaborative and project-based activities is highlighted in the paper as a key strategy for engaging adult learners. These activities encourage teamwork, peer learning, and the application of theoretical concepts in practical, real-world scenarios. This approach not only fosters engagement but also mirrors the collaborative nature of professional environments, thereby enhancing the relevance of the learning experience. *"I immediately saw that getting people engaged and taking the time to structure exercises that could be done in the formal breakout groups within the participants, clearly, was a very good idea."* This showcases the value placed on interactive and collaborative learning approaches.
5. **Feedback**: Instructors emphasized the importance of feedback in shaping the course content. This describes how feedback, particularly self-reflective feedback from students, was used not just for evaluation but as a tool for adapting and improving the course design. This approach recognizes the dynamic nature of the learning process and the need to continually adjust teaching strategies to meet the evolving needs of adult learners. The paper quotes, *"But I think that the in-person, it's much easier because you get that feedback from the students, right? You can see people's faces."* This emphasizes the critical role of feedback in adapting teaching strategies.

Each of these constructs reflects a deep understanding of andragogy, the art and science of teaching adults. They are tailored to meet the unique characteristics and needs of adult learners, particularly in the context of synchronous engineering professional development courses.

3.2.2 Dissemination of Findings

As mentioned above, one peer reviewed conference paper was published to disseminate the findings from the investigation on instructors' approaches and rationales to instructional design. This paper was published with and presented at the 2022 American Society for Engineering Education Conference in Minneapolis, Minnesota (Yaghoubisharif et al., 2022).

The key takeaways of this research paper were as follows:

1. Importance of self-directedness in adult education settings: Adult learners have a higher level of self-directedness than college learners. Self-directed learning is a process in which learners choose their topic, determine how they will learn more about it, and decide what they will do with the new information.
2. The role of the instructor in self-directed learning environments: Instructors act as facilitators and supporters rather than providers of information. They help adult learners and practitioners envision the application of the course content explicitly through the course design.
3. The benefits of implementing self-directed-related activities in continuing professional development (CPD) courses: Implementing these strategies and activities improved the course design and learners' engagement during CPD classes.
4. Life-centered experience in CPD learning environments: Learning through life situations can offer a better output than learning through subjects in adult education. Adult learners come with a wealth of personal knowledge and experience, and their orientation to learning is life-centered.
5. The importance of payoff expectation in CPD courses: Life-centered learning is an important attribute that distinguishes adult learners from university students.
6. Visualization technologies in active learning: One instructor talked about the pivotal role that the NHI course played in the development and the learners' engagement during CEPD classes.
7. Collaborative learning in CPD courses: Investing in the course design and implementing new learning strategies based on research helps in courses and the learners' engagement during CPD classes.
8. Project-based activities in CPD courses: These are vital strategies in all CPD courses, based on the feedback received from the adult learners.

This work provided valuable insights into how instructors incorporate active and adult learning strategies in their courses. Although the instructors we talked to made some effort to incorporate these into their courses, there is much work to do. With the wealth of literature supporting active learning and adult learning strategies, it is hoped that these practices can be more widespread as time goes on. Higher education courses face similar challenges, with evidence-based practices seeing limited implementation. One-on-one mentoring of faculty to facilitate implementation can be effective, but the instructors must have some willingness to change their teaching. We contend that successful and impactful CPD programs should follow the literature on what works, but very few do.

3.2.3 Survey Development: Measuring Work-Related Experience and Engagement of Adult Learners in Online CPD Courses

This effort aimed to construct a survey that would accurately gauge the experience and engagement levels of adult learners in the context of CPD online courses. By crafting this survey, we sought to gain an understanding of the presence of work-related experiences and activity in CPD courses for adult learners.

This survey could provide valuable insights into course offerings and the degree to which evidence-based practices have been implemented. To further the development, we would need to gather about 200 responses and conduct statistical analysis on the results. We are confident that doing so would

result in a valid, reliable, and widely implementable scale for PacTrans and others implementing CPD courses.

Introduction

In the realm of educational research, the formulation of scales to quantitatively assess pivotal constructs has emerged as an indispensable tool. This study concentrated on the development of a scale dedicated to gauging the nuances of work-related experience and engagement of adult learners. Devellis (2016) emphasized the imperative nature of a systematic approach in scale construction, encompassing the identification of key constructs, meticulous item generation, and robust validation processes to ensure both reliability and validity. This approach is vital for educators and course designers, as it provides a scientific method to quantify complex educational phenomena. A well-constructed scale allows educators to assess and refine their teaching strategies, ensuring that they are meeting the unique needs of learners.

In adult learning, contemporary learning theories such as self-directed, experiential learning, and authentic learning have always been critical components of adult learners' educational experiences. According to a UNESCO International Commission Report, it is essential to create awareness during the first initial education period that self-directed learning and continuous personal development are crucial in the workforce. Therefore, in the 21st century, the main objectives of traditional education should focus more on teaching learners how to acquire knowledge, skills, and abilities independently (Delors, 1998).

The development of a scale for measuring various aspects of CPD is essential. CPD should respect and utilize the experiential knowledge of professionals, as this contributes significantly to their ongoing development. This approach, known as "knowing-in-practice," emphasizes the importance of practical knowledge in professional settings (Trotter, 2006). Additionally, Ralph Brockett's assertion that effective adult learning is often collaborative underscores the need for environments that foster peer learning and community building (Anderson and Brockett, 2008). A well-constructed scale would also consider the relevance and applicability of CPD to professionals' practice, in line with their internal motivation and resistance to irrelevant content. This approach ensures that CPD remains relevantly engaging and promotes self-directed and experiential learning. Developing a scale to measure adult work-related experience and engagement in CPD is essential because adult learners in online collaborative environments display unique learning characteristics. This research area, highlighted by Abedini et al. (2017), emphasizes the importance of understanding how adults engage with peers and learning materials online and how this engagement affects learning outcomes (Abedini et al., 2017). Adult learners often juggle multiple life roles and face challenges transitioning to online learning. The scale would help in identifying and understanding these unique adult learning characteristics and the factors that facilitate or hinder engagement in online learning environments, thus contributing to improved learning outcomes.

To design the survey, we first investigated how instructors incorporate active learning strategies into their professional development courses. This investigation involved examining various teaching methodologies presented by instructors, followed by instructional design techniques in the literature, and the integration of these strategies to foster active learning. On the basis of these findings, we developed a comprehensive survey that included the five constructs. The survey was structured to not only gather specific data on the usage of active learning techniques but also to capture general

perceptions and experiences of learners in these environments. The ultimate goal was to create a survey tool that would be valuable for assessing and enhancing the quality of professional development courses.

Scale Development Steps

The following describes the development of our instrument for measuring adult learners' work-related experience and engagement, guided by the methodologies of DeVellis. This instrument was integral to our project focused on understanding key constructs that facilitate adult learners' engagement in online courses. We drew upon DeVellis' eight-step scale development process, adapting it to our educational context (DeVellis and Thorpe, 2021).

Step 1: Define Clearly What You Want to Measure: The first step, as outlined by DeVellis, involves understanding the constructs to be measured.

We commenced with qualitative interviews with instructors and the review of the current literature to uncover important constructs. From these interviews, combined with a comprehensive literature review, we identified core constructs essential for measuring social and cognitive engagement in online courses.

Steps 2,3,4: Generate an Item Pool, Determine the Format for Measurement, and Have the Initial Item Pool Reviewed by Experts: In Step 2, we generated a broad pool of questions related to the identified constructs. For Step 3, we decided on a 5-point Likert scale as the response format, ensuring that the items were appropriately structured. In Step 4, the item pool underwent a review by experts in engineering education to validate the content and relevance of the scale.

The following steps are necessary to complete the survey. We are prepared to implement the survey and complete it if an opportunity arises.

Step 5: Consider the Inclusion of Validation Items: This step involves including specific items in the survey that serve as a benchmark or standard for validation purposes. These items are usually drawn from well-established scales and are known to reliably measure similar constructs. Their inclusion helps to cross-validate the responses received on the new items, ensuring that the new scale correlates well with these established measures and is accurately capturing the intended constructs.

Steps 6 and 7: Administer Items to a Development Sample, and Evaluate the Items: Step 6 involves administering the newly developed items to a sample group that is representative of the target population. This is usually done via a pilot study. Step 7 involves evaluating the responses from the pilot study. This evaluation often includes statistical analyses such as exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to examine the structure of the scale and to confirm that the items are measuring the constructs effectively. This step also assesses the reliability and validity of the scale.

Step 8: Optimize Scale Length: The final step in scale development is to optimize the length of the scale. This involves making decisions about which items to keep and which to discard based on the data collected in the previous steps. The goal is to strike a balance between having enough items to reliably measure the constructs without making the scale so long that it becomes burdensome for respondents. This process often involves removing items that do not perform well (e.g., items that do not correlate strongly with the overall construct or have poor response variability) and refining the wording or format of remaining items for clarity and conciseness.

Purpose of the Survey

This survey aims to collect data to measure work-related experience and engagement of adult learners in CPD courses. Malcolm Knowles, a pioneer in the field of adult learning, showed that a learner's experience must be incorporated in adult education experiences, and measuring these concepts will provide a valuable tool in adult education and professional development. There are five validated dimensions in this scale: experience-centered, application of learning to the work, professional outcome, learning environment, and engagement. The collected data on the different learning strategies and concepts related to the work-related experience of adult learners can be used to measure and understand the impact on CPD courses on participants.

Note: All survey questions are on a 5-point Likert scale format from "Strongly agree" to "Strongly disagree."

Survey Questions

Experience-Centered. According to Knowles and Pintrich, adults learn continually and informally as they adjust and adapt to the continuously changing roles and other conditions in their work life. Adult learners use the experience they gain during their life and work as a resource, and this cannot be ignored (Knowles, 1970; Pintrich and De Groot, 1990). In CPD learning environments, the learners come with a wealth of personal knowledge and experience, and their orientation to learning is life-centered. Because of this, learning through life situations can offer a better output than learning through subjects in adult education. This concept is also one of the essential elements of work-related learning in adult education. The following statements measure the construct.

1. I encountered examples that relate to my work during the course.
2. I used my work experience to better understand course content.
3. I found similarities between the course content and my work experience.
4. I signed up for this course because I thought the content would be helpful in my work.
5. I was able to relate the course content to my work.
6. The course required me to think about my work-related experience to understand the content.
7. The course motivated me to think about work-related ideas.
8. This course made it clear how the course content related to my work.
9. During the course I became encouraged to share my work experiences with the class.

Application of Learning to the Work. With rapidly growing technology combined with increasing job responsibilities and fast-paced workplace environments, lifelong learning has become an essential aspect for adult learners in their everyday lives. Research has shown that the learning strategies related to work and everyday life can create development opportunities in the workplace, which can significantly affect workplace happiness. In this concept, we investigate the impacts of the application of learning to work for CDP courses. The following statements measure the construct.

1. I will apply what I learned in my work.
2. I don't think that this course will help me in my work.
3. I will continue to use what I learned in the course after the course ends.
4. This course will make it easier to handle future problems at work.
5. The course content will be applied to my job responsibilities.

6. I will approach my work differently based on what I learned in this course.
7. I will try different strategies in my work based on what I learned in in this course.

Professional Outcome (Goal-Oriented Learning). Many studies have shown that professional outcome is clearly related to career advancement and the development of satisfaction in individuals. Findings have suggested that individuals taking professional development courses are "independent, experience-centered, problem-centered, self-motivated, goal-oriented, and lifelong learners with the purpose to achieve professional outcomes." They want to see a reason for learning something, and learning should be applicable to work. Also, Cercone (2008) mentioned that adults want to know the rationale behind learning and its effect on their work or day-to-day life. In Knowles' scale, we evaluate this concept in CPD courses with the following statements.

1. I want to do well in the course for career advancement.
2. In this course, I wasn't interested in the content that were not related to my job
3. I want to learn this course because I want to do better at my job.
4. This course will help me get a certification (Such as a Professional Engineers License).
5. This course will help me advance in my job.
6. This course will help me attain my professional goals.

Learning Environment. Although learning environment is not directly associated with CPD courses and adult education, many studies have shown that it has a significant impact on many different educational settings and can help improve engagement, which ultimately results in a better learning experience. In this concept, we capture the learning strategies and techniques in the learning environment that directly or indirectly impact learners' work-related experiences. In classes with a more prosperous environment, learners have more opportunities to interact with each other, which can pave the way for sharing their work-related experiences.

1. I enjoyed the interaction with other students in the class.
2. The collaboration between the students did not improve the course.
3. Other students sharing their experiences distracted me from the course content.
4. The instructor supported students in collaborating with each other.
5. I benefitted from interacting with others during the class.

Engagement. There have been many strategies and activities in adult education to increase learners' engagement. However, in adult education and especially in professional development courses, learners respond differently to the learning strategies, and for each strategy, the effectiveness of engagement could be completely different. To be more successful in teaching adults, we need to capture the learners' engagement related to the provided strategies that are based on the principles of adult learning.

1. I only listened to the instructor during the course.
2. I used notetaking and handouts to better understand the materials.
3. I often asked questions to help me learn better.
4. In the class, I expressed my thoughts about the course content.
5. I shared my work-related experiences with other students in the class.
6. The instructor made the course enjoyable.

7. The instructor occasionally asked questions to make the class more active.
8. The instructor provided opportunities for the class to share their opinion on the subject.
9. The class included working on problems/exercises during class time.
10. The instructor directed students to do problems/exercises in the class
11. I worked on problems/exercises with other students during the class

Overall Assessment. (These are Open-Ended Questions.

1. What was the most effective part of this course?
2. What was the least effective part of this course?
3. What was the most valuable outcome / takeaway from the course?

Demographics and Participant Background. In the next section, we ask about demographic data.

1. Please select your gender.
2. Which race/ethnicity best describes you?
3. What is your age?
4. What is your occupation?
5. Where do you work?
6. How long have you been working there?
7. What is the highest degree or level of education you have completed?
8. Please indicate the engineering discipline(s) you are involved in. Check all that apply:
9. How many CPD courses have you taken in the last two years?

3.3 Education Activities for Undergraduate and Graduate Students

The education activities at Washington State University (WSU) also included funding and guiding graduate and undergraduate learning for students. Between 2021 and 2023 several students worked on transportation research, either as summer internship opportunities or dedicated educational and research activities. Below is a summary of these individuals at the graduate and undergraduate levels.

3.3.1 Undergraduate Students

Andrew Gutierrez	*2020 Economics Major*
Andrew Gutierrez was one of our top undergraduate students who worked one semester as an intern on a variety of transportation research projects. But his principal contribution was to videotape all the PacTrans principal investigators (PIs) across the different colleges on WSU's campus. This information allowed greater transparency and information sharing for prospective students, as well as better collaboration among faculty at WSU and elsewhere seeking partnership opportunities. The videos are brief descriptions of the PIs' research areas, the projects they are involved with, and the impacts expected. These videos can be viewed here: (https://ses.wsu.edu/research-project-videos/).	

Andy Burke	*2025 Civil Engineering Major*
Andy Burke was another top undergraduate student who worked for two semesters on public transit planning, mode choice, and parking planning. Andy worked to develop a survey of public transit users, conducted a thorough literature review of transport planning, and conducted a preliminary analysis of Pullman Transit data. Andy has a bright future in transportation planning and has continued his work in transportation within the College of Engineering. Andy is pursuing a career in transportation	

planning with WSDOT, and with support from PacTrans he has developed skillsets to be well prepared to address transportation planning challenges facing our region.

Martha Lum	*2022 Economics Major*

Martha Lum was an Honors Student who was interested in transportation challenges resulting from the pandemic. Her work was focused on how the pandemic affected export markets for products leaving Washington state, particularly agricultural products. She worked with containerized trade data over the past 15 years to identify impacts to specific markets resulting from supply chain disruptions caused by COVID-19.

Brent Monahan	*2024 Economics Major*

Brent Monahan is an Economics student in our Global Campus system who has interest and experience in supply chain management. With PacTrans support, Brent conducted research on the impacts of COVID-19 on the supply chain, using indicators such as the inventory-sales ratio, U.S. rail car volumes, and port employment. This work was particularly relevant to him as a current construction worker with first hand experience with supply chain disruptions. This project helped prepare him for career advancement into supply chain management, which is what he is pursuing with his degree.

3.3.2 Graduate Students

Jake Wagner	*2020 PhD*

Jake Wagner is now an assistant research professor in the School of Economics at WSU but began working on transportation studies as part of his graduate studies. His focus was on non-market valuation of commute time, infrastructure network optimization, and commuter mode and parking decisions. As a graduate student he contributed to PacTrans-funded research, and as an assistant research professor he continues to work alongside students on transportation and supply chain research. He has been involved in mentoring several students to have successful careers in the transportation and supply chain industry.

Timur Dincer	*2021 PhD*

Timur Dincer was another top graduate student who completed his PhD with a dissertation focused on transportation economics. He worked on several projects supported by PacTrans and was an integral leader in contributing to the organization and delivery of the 2021 PacTrans Student Conference. Timur's work included a systems-level optimization framework for public transit systems, optimizing service levels, ridership and profits under resource constraints. He presented this work at the 2022 PacTrans Conference. Timur was also involved in several freight and supply chain studies, evaluating the safety of agricultural trucks within the region, estimating intermodal competition in the railroad industry, and identifying opportunities for efficiency gains in the PNW timber trucking industry.

Brandon Bullard	*2021 Masters of Applied Economics*

Brandon Bullard completed his master's degree while working on transit research. He was involved in a study with Pullman Transit, the state's largest rural transit provider, aimed at improving transit ridership. The principal problem facing Pullman Transit is satisfying peak demand with limited

resources. Brandon tackled this problem by estimating determinants of ridership, so that ridership demand can be predicted at the stop-level. This effort is instrumental to being able to optimize transit systems, recognizing that demand is a function of system attributes in the network optimization process. Brandon has gone on to have a successful career as an Associate Industrial Engineer at Boeing, working on supply chain challenges for one of the Northwest's biggest industries.

Mengshan Zhao *2025 PhD*

Mengshan Zhao contributed to several transportation and supply chain research projects with support from PacTrans. She completed work with WSU Transportation Services to aid in optimizing parking policy to assist in cost recovery. This project also evaluated the impacts of parking characteristics on parking demand and location choices, which is useful in evaluating congestion policy. Mengshan also contributed to a supply chain project evaluating the impacts of COVID-19 on agricultural exports, with a particular focus on exports from PNW ports. This work was published the 2023 Washington Agribusiness Outlook and was presented at several conferences.

Wisnu Sugiarto *2023 PhD*

Wisnu Sugiarto is currently on the academic job market, having already published one journal article. He led research focused on estimating the value of highway wildlife crossings in mitigating vehicle accidents in Washington state. Wisnu also contributed to work on estimating the determinants of bulk truck freight rates, critical to addressing concerns over transportation pricing and truck services availability. Wisnu served as an active member in PacTrans and was integral in helping to organize the 2022 PacTrans Student Conference.

3.3.3 Papers Presented

Several of the students working on PacTrans projects also presented their work at conferences and outreach events. These are shown in Table 3-1.

Table 3-1. Published student papers

Student	***Paper***	***Conference / Date***
Jake Wagner	Commuters' Mode and Parking Decisions	WSU Seminar Series, 2020
Jake Wagner	Commuters' Mode and Parking Decisions	PacTrans Doctoral Webinar Series, 2021
Jake Wagner	Optimizing Efficiencies in Timber Truck Routing	PacTrans Student Conference, 2021
Timur Dincer	Transit Routing to Maximize Ridership	PacTrans Conference, 2022
Mengshan Zhao	Optimal Campus Parking Policy	PacTrans Conference, 2022
Jake Wagner	Efficient Routing of Shelter Animals	PacTrans Board of Directors, 2022
Martha Lum	Impacts of Export Trade on Farm Incomes	WSU Showcase Event, 2023

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CHAPTER 4. K-12 STEM OUTREACH

4.1 Background

The primary objective of the PacTrans K-12 science, technology, engineering, and math (STEM) program is to help increase the number of students pursuing advanced degrees and careers in STEM-related fields associated with transportation. This mission emphasizes a particular commitment to broadening the participation of women and minority groups within these fields. Ultimately, the program aims to contribute to the development of a skilled and diverse STEM workforce. Two separate summer camps were delivered to middle and high school students in the summer of 2023. The University of Washington and consortium partners also participate in annual STEM outreach events like the UW College of Engineering Discovery Days.

4.2 PacTrans-WSDOT High School Summer Camps

4.2.1 Overview of Camp Programs

The 2023 PacTrans-WSDOT Summer High School Transportation Camp was designed as a comprehensive, six-day, five-night residential program. It took place at two prestigious institutions: Washington State University (WSU) in Pullman from July 24th to 29th and the University of Washington (UW) in Seattle from August 13th to 18th. The 2023 program was generously sponsored by PacTrans and WSDOT and was offered free of charge to all participating students. Combined, the camps welcomed 33 students, with 25 at the UW and eight at WSU. The success of both camps was underscored by overwhelmingly positive feedback from students and parents.

The overarching goal of the PacTrans-WSDOT summer high school transportation camp program is to increase the number of students pursuing advanced degrees and careers in STEM fields related to transportation, with a particular emphasis on broadening participation among women and minority groups. Over time, the program aims to contribute to the development of a STEM-capable workforce. To achieve these goals, the program has the following objectives:

- Reach out to minority youth, young women, and disadvantaged individuals to introduce them to the opportunities within transportation-related STEM fields.
- Increase awareness among high school students about the diverse and rewarding careers available in the transportation industry.
- Encourage and inspire high school students from diverse backgrounds to consider pursuing a vocation in transportation.

The PacTrans-WSDOT summer high school transportation camp program's impact extends far beyond its immediate participants. By increasing the number of students pursuing advanced degrees and careers in STEM fields related to transportation, the program not only fosters individual growth but also contributes to the overall vitality and innovation of the transportation industry. Furthermore, our commitment to broadening the participation of underrepresented groups, including women and minorities, enriches the industry's diversity and inclusivity, leading to more comprehensive solutions and a workforce that reflects the society it serves. Over time, our dedication to delivering a STEM-capable workforce will ensure that the transportation sector remains at the forefront of technological advancements, sustainability, and resilience. Through outreach, awareness-building, and

encouragement, our program actively shapes a brighter future for both aspiring young talent and the transportation field as a whole.

4.2.2 Camp Planning

The planning, development, and successful execution of this program were led by key personnel from the UW, with valuable coordination and collaboration from the WSDOT and WSU. The UW led the efforts in proposal writing, program planning, program development, and final report preparation. Meanwhile, the schedule development, logistics, and execution of each camp were managed by dedicated teams from the UW and WSU. Table 4-1 lists all key personnel involved in the 2023 PacTrans-WSDOT Summer High School Transportation Camp project.

Table 4-1. Key personnel and their responsibilities

Name	Organization	Role	Responsibilities
Yinhai Wang	UW	Program Supervisor	Oversee program planning, development and administration; provide strategic directions.
Pamela Vasudeva	WSDOT	Consultant	Provide guidance and support in the planning, development, and administration of programs
Doug Brodin			
Anne V. Moudon	UW		
Lingzi Wu	UW	UW Camp Director and Host	Lead all UW Camp planning, development, and execution; Support WSU Camp planning and development
Sam Ricord	UW	UW Camp Coordinator	Assist with UW Camp planning and development
Ruyi Chen	UW	UW Camp Coordinator	Website and online application form development
Ollie Wiesner	UW	Residential Counselor	Support the Camp Host to create a welcoming and safe environment; Assist with any emergencies or issues that may arise during the camp; Supervise and support camp participants
Annie Davis	NA		
Melanie Paredes	PacTrans/UW	Financial Coordinator	Process payments and administrative support
Jia Li	WSU	WSU Camp Director and Host	Lead all WSU Camp planning, development, and execution
Mary Aina	WSU	WSU Camp Coordinator	Assist with WSU Camp planning and operation
Erin Rapone	WSU	WSU Camp Coordinator	Assist with Camp transportation and logistics
Randall Bennett	WSU	WSU Camp Coordinator	Assist with Camp lodging and dining

The UW camp accepted 27 students. Pie charts and a map of the accepted participants' demographics are presented in Figure 4-1.

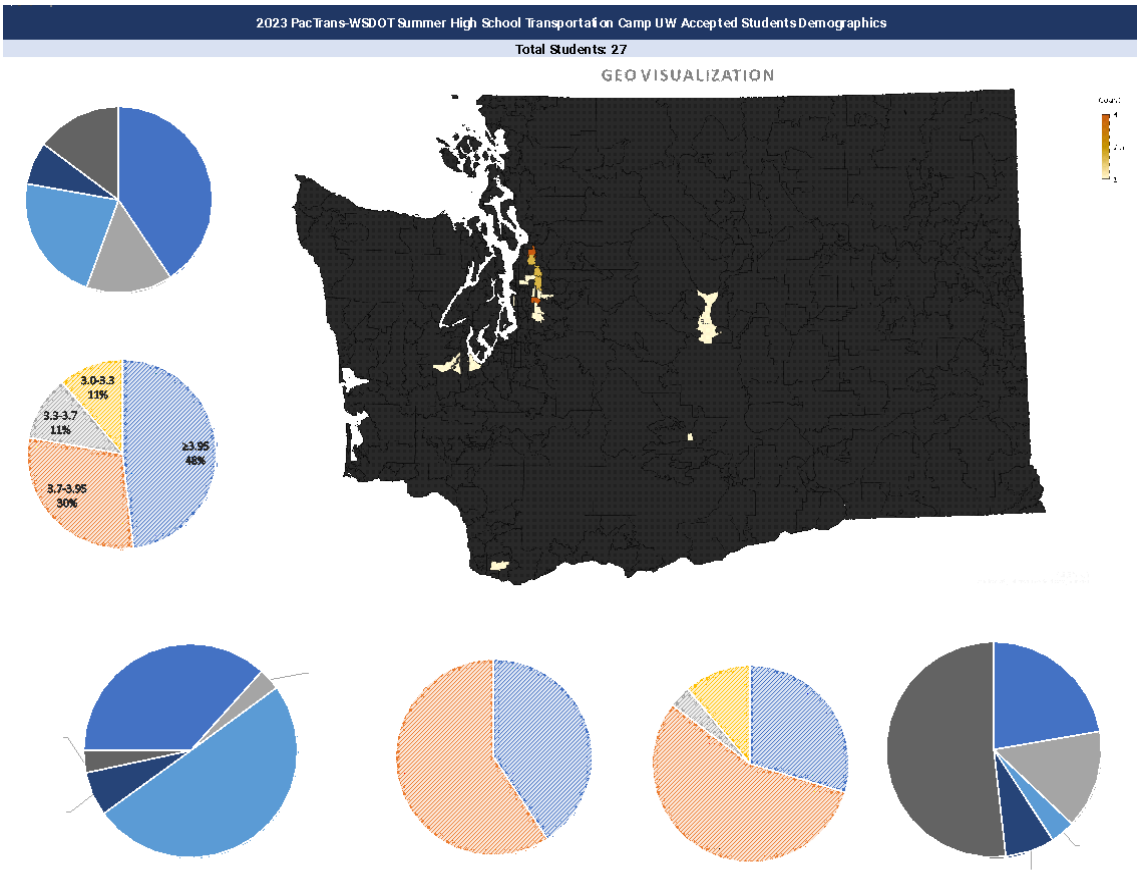

Figure 4-1. Accepted UW participants' demographics

The WSU camp received 16 applications and accepted eight students. Figure 4-2 shows the geographical locations of applications.

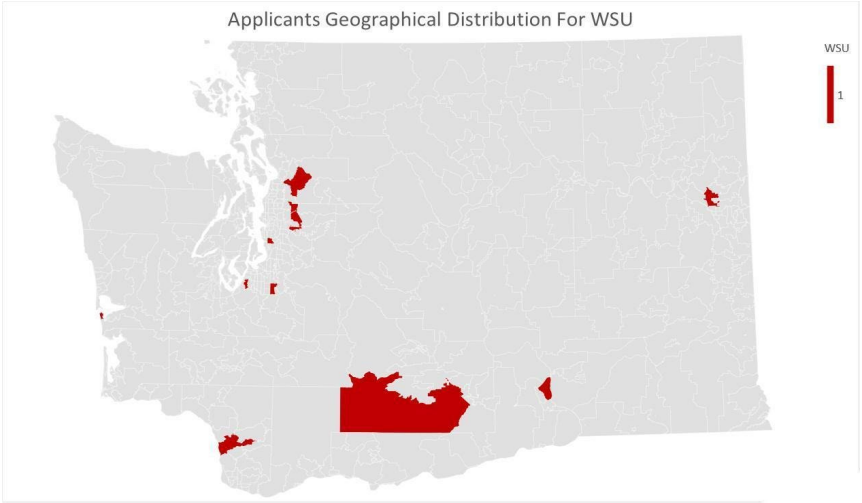

Figure 4-2. Accepted WSU participants' zip codes

During the program planning and development phase, our team placed special emphasis on strategies intended to attract a diverse group of young individuals to engage in STEM fields related to transportation. Some of the key strategies we adopted included the following:

1. *Targeted Outreach and Recruitment*: We directly engaged with several high schools that serve underrepresented students to provide them with program information and encourage their participation.
2. *Scholarships and Financial Support*: We made the entire six-day, five-night camp free for all students. Additionally, we developed plans to offer financial support to students who might require assistance with travel expenses from their hometowns to the camp locations.
3. *Inclusive Program Curriculum Development*: Our planning and development team comprised experts in civil engineering, transportation engineering, urban design and planning, and construction management. This diverse expertise allowed us to create a curriculum that incorporated a wide range of perspectives and experiences.
4. *Data Collection and Analysis*: We implemented a systematic approach to collect demographic data about program participants. These data served as a valuable tool for measuring the effectiveness of our diversity, equity, and inclusion (DEI) efforts. We analyzed these data to identify areas for improvement and to make necessary adjustments to our strategies.

These strategies collectively reflected our commitment to fostering DEI in our program, ensuring that all young individuals have the opportunity to explore and thrive in STEM fields related to transportation.

To establish a comprehensive set of student evaluation criteria, we drew from recommendations provided in the *National Summer Transportation Institute Program Desk Reference*, a publication by the USDOT and the FHWA (USDOT and FHWA, 2019). Their suggested criteria included factors such as ages ranging from 7th to 12th grade, completion of basic algebra or qualification for enrollment in algebra for the upcoming school year, desire for a STEM education, and a minimum cumulative grade point average of 2.0 or higher on a 4.0 scale.

On the basis of these guidelines, our planning and development team devised a two-level evaluation system of prequalification and evaluation criteria. To be eligible for the program, participants had to meet the following requirements:

- Be a Washington resident
- Be enrolled in a Washington high school in the fall of 2023 (9th to 12th grade)
- Be able to attend the entire duration of the camp in person
- Have a 2.0 GPA or higher.

The evaluation criteria included the following six categories:

1. *Interest in Transportation:* We prioritized students who exhibited a genuine interest in transportation engineering or related fields, such as planning, logistics, or geography.
2. *Performance*: We considered students with a fairly strong academic track record in math, science, and engineering-related courses, as they demonstrated the capability to engage with the camp's curriculum effectively.

3. *Diversity, Equity, and Inclusion (DEI)*: We aimed to foster a diverse learning environment by selecting students from various backgrounds and experiences, promoting inclusivity and collaboration.
4. *Service Experience*: We looked for students who had demonstrated strong teamwork skills. This could be evaluated through their participation in team projects, group activities, or community service.
5. *Communication Skills*: We looked for students who had strong communication skills, as well as an ability to work in groups and present their ideas. This could be evaluated through their written and oral communication.
6. *Leadership Potential*: We considered students who had exhibited leadership potential in school or community activities, indicating their capacity to take initiative, work independently, and inspire others.

Our holistic approach to evaluating students encompassed these six criteria, ensuring a well-rounded and diverse group of participants who could benefit from and contribute to the program's objectives. Table 4-2 outlines the proposed weight distribution for each criterion and the supporting application materials associated with it.

Table 4.2. Applicants' evaluation criteria

Criteria	Weight (100%)	Score (1-100)	Supporting Materials
1. Interest in transportation	30%	1-30	● Personal Statement ● Introduction Video ● Letter of Recommendation ● Career Interest
2. Performance	30%	1-30	● GPA ● Transcript ● Letter of Recommendation ● Recent Math and Science Class
3. DEI			● Geographic Location ● Race/Ethnicity ● Sex ● Gender Identity ● Household Income ● Grade/Age
4. Service experience	15%	1-15	● Personal Statement ● Letter of Recommendation ● Awards/Achievements/Organization Memberships and Other Extracurricular Activities
5. Communication skills	15%	1-15	● Personal Statement ● Letter of Recommendation ● Introduction Video
6. Leadership potential	10%	1-10	● Personal Statement ● Letter of Recommendation ● Awards/Achievements/Organization Memberships and Other Extracurricular Activities
Overall	100%	100	

4.2.3 Schedule Development

University of Washington

The development of the UW camp schedule followed a structured process involving the following key steps:

Step 1: Concept Design - The UW planning team, led by Professors Wang and Wu, determined the main activity groups for the camp. These groups included

- Student-led projects
- Participatory lectures
- Field trips/site tours/lab visits
- Evening activities.

Step 2: Brainstorming - Multiple brainstorming sessions were conducted to generate ideas and examples for each of the activity groups outlined in Step 1.

Step 3: Theme Development - Building on the brainstormed activities, the UW planning team identified five main themes for the camp:

- Introduction to Transportation
- Transportation Safety and Equity
- Active Transportation, Public Transit, and Sustainability
- Integrated Transportation System, Supply Chain, and Logistics
- Transportation Technology.

These themes served as the foundation for organizing the participatory lectures, field trips/site tours, and lab visits.

Step 4: Schedule Logic Development **-** The five themes from Step 3 were logically assigned to each day of the week (Monday through Friday) based on the progression from foundational knowledge to more advanced topics. Once daily themes had been established, participatory lectures, field trips/site tours/lab visits, and project work times were allocated to each day. The planned distribution was approximately 40 percent for participatory lectures, 30 percent for field trips/site tours/lab visits, and 30 percent for project work time.

Step 5: Student-Led Project Design - A student-led project was designed to align with the camp schedule, allowing students to apply what they learned each day. The chosen project focused on designing a multimodal complete street section, selected from various project ideas.

Step 6: Speaker and Presenter Coordination - The UW planning team reached out to potential speakers, presenters, and tour guides to finalize locations and dates for the camp activities.

Step 7: Evening Activities Development - The UW planning team concluded by finalizing the evening activities to complement the daily curriculum.

A high-level view of the final schedule, including the distribution of activity groups, is presented in Figure 4-3. Note that 1) only major activities (longer than 45 minutes) are listed here, while activities such as daily debriefing or bio breaks are not broken out; and 2) the time allocated for tours includes travel time.

Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Date	8/13/23	8/14/23	8/15/23	8/16/23	8/17/23	8/18/23
Theme		Introduction to Transportation	Transportation Safety and Equity	Active Transportation, Public Transit and Sustainability	ITS, Supply Chain and Logistics	Transportation Technology and Project Presentation
8:00 - 9:00		Breakfast	Breakfast	Breakfast	Breakfast	
9:00 - 10:00		Introduction and Pre-Survey	Transportation Safety - Hollyanna Littlebull	Equity - Angela Kitali	ITS - Wei Sun	
10:00 - 11:00		Transportation Opportunities and Challenges - Allison Camden & Pam Vasudeva	Incident Management at TMC - Trent Alden	Sustainability - Rubnia Singh, Tianqi Zhou	DEI and Disability Rights - Anna Zivarts	To-Go Breakfast, PACCAR Test Center Tour
11:00 - 12:00		Lunch	Accessibility - Jon Froehlich	Lunch	Lunch and Star Lab Visit	
12:00 - 1:00		Visit NW Region TMC	Lunch & Project Work Time	Public Transit - Mark Hallenbeck		Lunch
1:00 - 2:00				Walking Tour of Complete Streets/Project Example	Amazon Fulfillment Center Tour	Project Work and Preparation Preperation
2:00 - 3:00		Project Introduction and Work Time	Metro Electric Testbed	Project Work Time	Project Work Time	Closing Remarks - Roger Millar
3:00 - 4:00	Student Check In					Final Project Presentation
4:00 - 5:00	Orientation & Dinner	Dinner Ice Cream and 43rd St Redesign Presentation	Dinner Game Night at HUB	Dinner Transportation Themed Movie Night	Dinner Reflection and Evaluation	
5:00 - 7:00						
7:00 - 9:00	Ice Breakers					

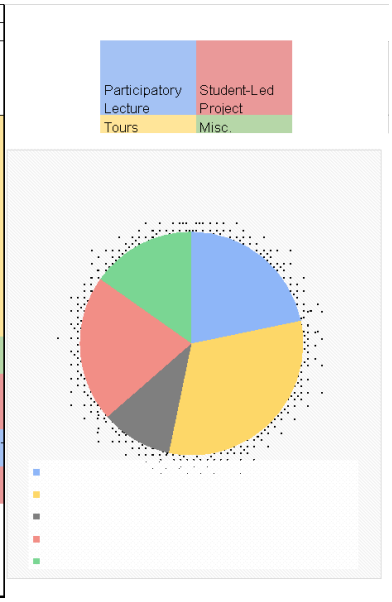

Figure 4-3. 2023 UW Camp final schedule and activity distribution

Figure 4-4 shows photos from course activities.

Figure 4-4. Examples of field trips, tours, and lab visits (UW)

Washington State University

The development of the WSU camp schedule followed a structured process involving the following key steps:

Step 1: Concept Design – The WSU planning team, led by Professor Li, with coordination by Pamela Vasudeva and input from the UW planning team, determined the main activity groups for the camp. These groups included

- Student-led projects
- Participatory lectures
- Field trips/site tours/lab visits
- Recreational activities.

Step 2: Theme Development – The WSU team identified the following themes for the camp:

- Introduction to Transportation
- Artificial Intelligence and Technologies in Transportation
- Transportation Materials and Infrastructures
- Diversity, Equity, and Inclusion (DEI) in Transportation
- Multimodal Transportation
- Tribal and Rural Transportation.

These themes served as the foundation for organizing the participatory lectures, field trips/site tours, and lab visits.

Step 3: Schedule Logic Development **–** The six themes from Step 3 were logically assigned to each day (Monday through Saturday) based on activity type, student preparations needed, and logistics. To enhance students' learning experience, we blended different themes and camp activities for each day. The planned distribution was approximately 45 percent for participatory lectures, 25 percent for field trips/site tours/lab visits, and 30 percent for project work time.

Step 4: Student-Led Project Design – A student-led project was designed to align with the camp schedule, allowing students to apply what they learned each day. Two projects were developed: 1) applying Python to analyze traffic crash data; and 2) assembling and controlling robocars to overcome barriers.

Step 5: Speaker and Presenter Coordination – The WSU planning team reached out to potential speakers, presenters, and tour guides to finalize locations and dates for the camp activities.

Step 6: Recreational Activities Development- The WSU planning team developed a schedule of recreational activities to complement the daily transportation curriculum.

Step 7: Schedule Finalization – The WSU planning team finalized the schedule after incorporating feedback from WSDOT and the UW planning team and confirming the logistics and speaker availability.

A high-level view of the final schedule is presented in Figure 4-5. The colors differentiate different types of activities (blue: opening and closing talks; yellow: talks and tours given by WSDOT personnel; orange: talks and tours given by WSU faculty; pink: road trips; green: student projects). Figure 4-6 shows photos of course activities.

Pactrans - WSDOT Summer High School Transportation Camp Schedule

	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul
TIME	Location: PACAAR & SLOA	Day 2 Location SPRK 3	Day 3 Location Commo	Day 4 Location Commo	Day 5 Location Commons	Day 6 Location Commo
6:00 - 7:00 AM		Wake up & Clean up	Wake up & Clean up	Wake up & Clean up	Wake up & Clean up	Wake up & Clean up
7:00 - 8:30 AM		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast
9:00 - 10:00 AM		Goal Setting Workshop Speaker from Academic Success and Career Center Venue: SPRK 327	Talk by Dr. Xianming Shi (Concrete Pavement) Venue: PACCAR 202	Talk by Dr. Kishor Shrestha Venue: PACCAR 202	Financial Literacy Workshop Maja Gillespie The Commons 210	Talk by Dr. Jia Li (Traffic Safety) Venue: PACCAR 202
10:00 - 11:00 AM			Tour to WSU Creamery & Ferdinand Ice-Cream WSU Creamery Peer Mentors and Mary Aina	Movie Commons 210		
11:00 - 12:00 PM	Arrival, Registration & Check-in Venue: Global Scholar's Hall Peer Mentors & Mary Aina		Talk by Dr. Ayumi Manawadu Venue: PACCAR 202	WSU Jordan Schnitzer Museum of Art Peer Mentors & Mary Aina		Group Project Presentation (PACCAR 202) Anthony Apalla, Jia Li
12:00 - 1:00 PM			Lunch	Lunch		Lunch
1:00 - 2:00 PM		Spokane Tour Depart at 10 AM, arrive by noon 1.WSDOT TMC •Glenn Wagemann •Charlene Kay •Barb Chamberlain 2.Spokane MPO - SRTC (Eve McMenamy) Backup (riverside walk)	Physics Demonstration Physics Research Laboratory Tom G. Johnson	Field Trip to Schweitzer Engineering Laboratories (SEL) SEL Pullman		Talk by Dr. Xianming Shi (Winter Road Maintenance) Commons 210
2:00 - 3:00 PM	Talk by Secretary Roger Millar Venue: PACCAR 202		Chemistry Demonstration Chemistry Department Nishida Chrystal	Talk by Mike Gribner (WSDOT) Venue: PACCAR 202	Nez Perce Tribe, Lewiston Port & Rail and Wawawai County Park Depart for Lewiston Port @ 2 PM (1 hour tour by Whitman Port) Anthony Apalla, Patty Kieburtz, Randall Bennett	Camp closes
3:00 - 3:15 PM	Bathroom Break/Buffer		Bathroom Break/Buffer	Bathroom Break/Buffer		
3:15 - 4:15 PM	Talk by Dr. Jia Li (ITS) Venue: PACCAR 202		WSU Tour : CUB Facilitated by Peer Mentors	Talk by Anna Zivarts (Disability Rights) Venue: PACCAR 202		
4:15 - 4:30 PM	Bathroom Break/Buffer		Bathroom Break/Buffer	Bathroom Break/Buffer	Bathroom Break/Buffer	
4:30 - 5:30 PM	PACCAR & WCAT lab Visit Coordinated by Jia Li & Barzegar Mohammadreza	Panel Discussion Peer Mentors Venue: Commons 210	Games Peer Mentors Venue: Commons 210	Reflection, Journaling, and Creative Writing The Commons 210 Peer Mentors and Mary Aina	Idaho Arboretum	
5:30 - 6:30 PM	Dinner	Dinner	Dinner	Dinner	Dinner	
6:30 PM - 8:00 PM		Group Project (Traffic Data Analysis) Coordinated by Anthony Apalla Venue: Commons 210	Group Project (Robo-Car I) Coordinated by Anthony Apalla Venue: Commons 210	Group Project (Robo-Car II) Coordinated by Anthony Apalla Venue: Commons 210	Group Project (Robo-Car III) Coordinated by Anthony Apalla Venue: Commons 210	
8:00 - 9:00 PM	Movie @ the Commons Coordinated by Peer Mentors	Evening Active Field play Facilitated by Peer Mentors	Evening Active Field play Facilitated by Peer Mentors	Evening Active Field play Facilitated by Peer Mentors	Evening Active Field play Facilitated by Peer Mentors	
9:00 - 10:00 PM	Rest & Sleep	Rest & Sleep	Rest & Sleep	Rest/Sleep	Rest/Sleep	
10:00 PM - 6:00 AM	Lights Out	Lights Out	Lights Out	Lights Out	Lights Out	

Figure 4-5. A high-level view of the final WSU schedule

Figure 4-6. Examples of participatory lectures (WSU)

4.2.4 Application Review (UW and WSU)

By the published priority deadline of May 31, 2023, we had received 57 applications for the UW camp. The application review process commenced immediately for the UW camp, as we had reached our optimal applicant pool size. By the deadline of June 15th, we had received 14 applications for WSU (two late applications were received and considered after the deadline).

The UW evaluation committee comprised the following key personnel: Prof. Yinhai Wang, Prof. Lingzi Wu, Prof. Anne Moudon, Pamela Vasudeva, and Sam Ricord. To mitigate unconscious bias, all applicant

names were anonymized for the evaluation team. Each member of the evaluation committee individually assessed all applicants. Subsequently, all evaluations were compiled and summarized on the basis of the number of “accept” ratings that each student received from every evaluation committee member.

The WSU evaluation committee comprised the following key personnel: Prof. Jia Li, Pamlea Vasudeva, Prof. Anne Moudon, and Prof. Lingzi Wu. To mitigate unconscious bias, all applicant names were anonymized for the evaluation team. Each member of the evaluation committee individually assessed all applicants and gave a “recommend” or “not recommend” evaluation along with detailed comments. Students were accepted if they received more than two recommendations. Subsequently, 13 of the 16 applicants were offered acceptance to the WSU camp.

4.2.5 Student Evaluations and Learning Outcomes

Questions	Pre-Survey Count	Pre-Survey %	Post-Survey Count	Post-Survey %
1. How well do you feel you understand your community's transportation options?				
a) Quite well – I could explain these in detail	2	8%	22	88%
b) Somewhat well – I could explain certain aspects in detail	20	80%	3	12%
c) Not well – I could only explain minimal details	3	12%	0	0%
2. How well do you understand your community's shortcomings with regard to transportation options?				
a) Quite well – I could explain these in detail	8	32%	22	88%
b) Somewhat well – I could explain certain aspects in detail	8	32%	2	8%
c) Not well – I could only explain minimal details	9	36%	1	4%
3. Do you notice any parts of your community that are less well served by transportation options than others?				
a) Yes, I notice several groups in my community whose transportation options are worse than others.	8	32%	17	68%
b) Yes, I notice some groups in my community with worse transportation options but am not sure of the total extent of these shortcomings.	11	44%	8	32%
c) No, I am not aware of any shortcomings to members of my community	6	24%	0	0%
4. Can you describe the safety concerns present in your community?				
a) Quite well – I could explain these in detail	4	16%	16	64%
b) Somewhat well – I could explain certain aspects in detail	14	56%	9	36%
c) Not well – I could only explain minimal details	7	28%	0	0%
5. Can you describe aspects of your community where multi-modal options (non-car e.g., bicycle, walking, public transit) are prevalent and where they are lacking?				
a) Quite well – I could explain these in detail	9	36%	21	84%
b) Somewhat well – I could explain certain aspects in detail	12	48%	4	16%
c) Not well – I could only explain minimal details	4	16%	0	0%
6. Can you describe the issues surrounding sustainability present in our transportation network?				
a) Quite well – I could explain these in detail	6	24%	19	76%
b) Somewhat well – I could explain certain aspects in detail	11	44%	6	24%
c) Not well – I could only explain minimal details	8	32%	0	0%
7. Can you describe how technology can play a role in addressing some of the transportation challenges highlighted in previous questions?				
a) Quite well – I could explain these in detail	5	20%	20	80%
b) Somewhat well – I could explain certain aspects in detail	12	48%	4	16%
c) Not well – I could only explain minimal details	8	32%	1	4%
Overall				
a) Quite well	42	24%	137	78%
b) Somewhat well	88	50%	36	21%
c) Not well	45	26%	2	1%

Figure 4-7. UW students' pre-survey and post-survey outcome results

Evaluation Results (UW)

The UW team developed a comprehensive evaluation form covering various aspects of the camp, including camp experience, camp activities and learning, camp organizers and staff, facilities and accommodations, and overall evaluation and suggestions. Remarkably, the UW camp received feedback from 17 respondents out of 25 students, representing a robust 70 percent response rate. The feedback from students was overwhelmingly positive.

Recommendations (UW)

Accommodations: In future years, we could consider offering double-room accommodation options to students, providing more flexibility based on their preferences.

Promotion Channels: To enhance diversity among participants and improve the overall quality of the cohort, we should explore additional promotion channels. Expanding outreach efforts to attract students from various backgrounds would enrich the camp experience.

Non-Washington Residents: Evaluating the feasibility of extending the application to non-Washington residents could help broaden the program's reach and foster a more diverse participant group.

Camp Schedule: Given the high level of student engagement and interaction, we should consider optimizing schedules to ensure adequate time for questions and discussions. For example, allocating additional time for tours and bio breaks could enhance the overall experience.

Summer Heat Preparedness: To address potential discomfort during hot summer days, we recommend reserving air-conditioned or basement classrooms for lectures and activities, ensuring a more comfortable learning environment for participants.

Additional Student Support: Having an on-call student assistant who is familiar with the campus, classroom logistics, and the daily schedule would be beneficial. This individual could serve as a backup resource, assisting with equipment/room setup, and serving as a contact person in case of unexpected issues.

Evaluation Results (WSU)

Two surveys were conducted on the last day of the camp. All participants provided feedback through the survey. The main results are summarized in Table 4-3. Overall, we observed that the students were satisfied with the camp, given their levels of satisfaction, their ratings of activities, and their likelihood of recommending this camp to friends and classmates. Students attended this camp for a diversity of reasons, among which “career exploration” and “interest in transportation” ranked as the top two. Regarding the camp activities, the hands-on components were most attractive to the students. They mentioned feeling more engaged and interested in tours and lab visits, and hoping the presentations were more hands-on and less repetitive. For instance, one student said, *“The asphalt and cement professor. I liked going into the classrooms and looking around. My favorite part was getting to touch the materials (he gave me a cylinder of clay!).”* As for scheduling, they suggested adding break time between talks, and “*Maybe having our group projects in the morning instead of the evening would be nice. By the evening, we were all exhausted.*”

Through this camp, students learned more about the transportation industry. One student mentioned his/her key takeaway from this camp: “*It showed me all of the different jobs in transportation, how almost anyone can work in it, and all the possible jobs I could pursue.*” Another student said, “*I liked to*

see how their [there] is any job possible to any student and how you have so many options to do in the future also learned about transportation careers which many students wouldn't even know." The parent of a student sent a thank you email after the camp, saying, "*I wanted to take the time to thank you for this summer week camp. My son [student name] truly enjoyed the experience and loved to discover the campus. He loved the science, activities and made some friends.*"

Table 4-3. Evaluation analysis, WSU

Evaluation Question	Result
Overall satisfaction with the camp	● 7 "very satisfied" or "satisfied" ● 1 "neutral"
Primary motivation to attend the camp	● 6 "Career exploration," 3 "Interest in transportation," and 2 "Improving problem solving skill," and 1 "learning about WSU"
Rate quality of camp activities	● 3 "Excellent," 2 "Good," 2 "Average," and 1 "Poor"
Most engaging and beneficial activities	● Spokane tour ● Tour of asphalt lab and SEL ● Physics and chemistry demonstration
Suggestion for improvements	● Hands-on presentation ● Less repetitive talks
Likelihood of recommending to a friend/classmate	● 4 "very likely," 2 "likely," and 2 "neutral"

Recommendations (WSU)

We identified the following issues to improve for future camps.

- Recruitment
    - Plan early and develop a more systematic approach to reach high school students (e.g., contacts of local school districts, social media, advertisement, etc.).
- Program planning
    - Include more interactive tours and lab visits and reduce the length and number of presentations, especially presentations of similar topics.
    - Arrange student project in the morning.
    - Add breaks between sessions.
- Logistics
    - Send a detailed packing list and dietary questionnaire before the camp.

4.3. PacTrans-UW Youth and Teen Program Middle School Course on Autonomous Vehicles

4.3.1 Overview of Course Program

In 2021 PacTrans established a partnership with the University of Washington Continuum College's Youth and Teen Program. This program offers in-person and online courses for students entering fourth through 12th grades. While the program has offerings throughout the year, the majority are during the summer.

PacTrans worked with the UW Youth and Teen Program to develop a middle school offering called "Introduction to Autonomous Cars." During this two-week course, students split their days between (1) learning about the transportation industry from guest speakers and on-campus tours, and (2) building

their own “autonomous vehicles” using LEGO Educational SPIKE kits. The UW Teen and Youth Program handled most of the logistics, including space rental, marketing and advertising, registration, certifications and trainings, and more. The PacTrans team provided the instructors, the curriculum, and the hardware and software needed for the course.

The learning portions of the course included presentations from industry and agency leaders such as a presentation on transportation safety from the Washington State Lead Traffic Engineer, the future of transportation from the Principal Technologist with HNTB Corp., and automated logistics operations from the Director of the Master’s of Supply Chain Transportation Logistics program at the UW. Students also had the opportunity to visit research labs on the UW campus, including the Smart Transportation Application and Research Lab and the Driving Simulator Lab. Finally, the course offered presentations by local robotics clubs at the middle school, high school, and collegiate levels.

During the hands-on portions of the course, students were broken up into groups of two or three and provided (1) a laptop, (2) a LEGO Educational SPIKE kit, and (3) an expansion kit (Figure 4-8). These kits come equipped with a battery/cpu, an assortment of LEGO pieces and wheels, several motors of various sizes, and four different types of sensors (distance sensors, gyro sensors, pressure sensors, and color sensors). The kits also include access to LEGO’s educational software, which allowed students to utilize drop block code to create programs that controlled the robot vehicles.

Figure 4-8. LEGO educational SPIKE kits with expansion kits

Students progressively built more and more complex robots to add motors and sensors to their vehicles. Given that there was no prerequisite for coding experience, each day there were a series of presentations introducing the students to the various genres of code blocks and how they could be utilized (Figure 4-9). Each day, the groups were given missions to accomplish that incorporated the new blocks they had learned that day while still relying on the blocks they had learned in previous classes.

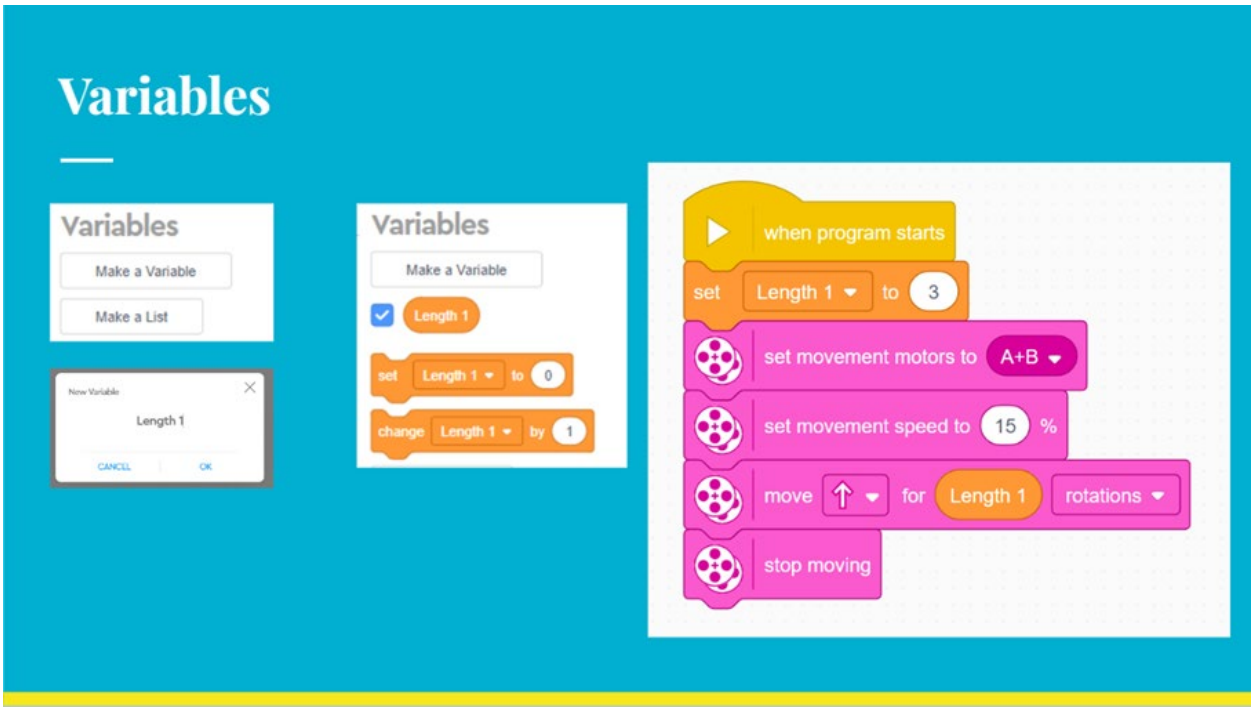

Figure 4-9. A presentation slide showing the software block code for variables category

By the end of the first week of classes, students had learned about all of the different block categories that this software offers. The work time in the second week was devoted to final projects. For the final project, in their small Week 1 groups, the students had to identify some type of vehicle and then identify tasks that their vehicle needed to accomplish (e.g., a snow plow needed to follow a line, reap debris [snow], and drop it at a predetermined location). Once the teams had their vehicle and functions identified, they spent Week 2 building a custom vehicle and creating the code that would allow their vehicles to automate all of the identified tasks.

At the culmination of the course, family and friends were invited to attend final presentations (Figure 4-10), at which students had up to five minutes to discuss the vehicles and tasks they chose and then run their code to make their vehicles perform the functions they programmed.

Figure 4-10. Images of our daily presentations and the student final project presentations

4.3.2 Results

The inaugural offering of this course occurred in the Summer of 2022. Twenty-five spots were offered, and each had been filled, on a first-come-first-served basis, within a week of registration launch. During the summer of 2023, because of significant interest in the course, the UW Teen and Youth Program encouraged PacTrans to host two offerings of the course. The first camp filled to the full 25 student capacity, and the second to 22.

In all three offerings, the course instructors received unambiguously positive feedback from both the students and their parents. Many parents were interested to know what their students could do as next steps because they enjoyed the course so much. The course instructors directed parents and students to

FIRST Lego League (FLL) and FIRST Tech Challenge (FTC) as opportunities to continue pursuing robotics and coding experience. The instructors have established relationships with both FLL and FTC teams in the greater Seattle area and have offered to connect parents with a student team in their area.

4.3.3 Moving Forward

PacTrans is currently working with the UW Teen and Youth Program for summer 2024 offerings. This will include one offering of "Introduction to the Autonomous Car," and a new, intermediate offering so that students who have previously taken the Intro course will have a second-level course opportunity. PacTrans is also exploring the addition of non-autonomous-vehicle courses through this program.

4.4 Reference

United States Department of Transportation and Federal Highway Administratoin, 2019, *National Summer Transportation Institute Program Desk Reference*.
https://www.dot.state.al.us/programs/pdf/NSTI/ProgramReferenceGuide.pdf

CHAPTER 5. GUIDEBOOK FOR CURRICULUM DEVELOPMENT, IMPLEMENTATION AND EVALUATION

5.3. Overview

For the PacTrans WDI to develop and deliver high-quality training services to working professionals, it is critical to develop a guidebook on how to implement best practices in design, implementation, and evaluation of training courses. The research team has developed and updated the guidebook iteratively over the training course development.

The purpose of this document is to provide guidance for the development, implementation, and evaluation of these courses. Course development is ubiquitous to colleges and universities and professional development efforts. A wealth of research and evidence supports a wide range of practices that can be implemented. There is also an abundance of experience and intuition from expert teachers that leads to positive and impactful course experiences. This guidebook combines research on effective educational practices with experience from teaching. Educational best practices include course development processes with carefully designed learning outcomes and associated learning activities (J. Biggs, 1996; Wang, et a., 2013), active learning strategies (Chi and Wylie, 2014; Prince and M.J., 2004; Smith, et al., 2005), reliable assessment and evaluation processes of learning (Reddy and Andrade, 2010; Wollenschläger, et al., 2016), and overall program and course evaluation (Project Star, 2006).

5.2 Adult Learning

Adult learning theory provides a useful lens through which to view professional development efforts because it provides theory and context for the particular needs of adults as they engage in learning experiences. Adults are considered in this context to be those individuals who engage in a learning experience of their own choice and who do so in relation to professional development needs related to their job and/or profession. Adults, therefore, normally enter into these learning experiences assuming that there will be specific value to them in relation to their reasons for signing up for the experience. Adult learning, and more specifically, andragogy, holistically describes aspects of the learner that are important to consider in this context.

There are five unique attributes of adult learners (Knowles et al., 2014). As noted, five principles are core to andragogy. First, adult learners probe "… into the benefits they will gain from learning it and the negative consequences of not learning it" (Knowles et al., 2014). They contemplate the benefits of the content to their jobs and lives and do this throughout the learning process. Therefore, the course designer needs to incorporate this by including content about why the content is important to the course participants and elicit this information from participants.

Second, adult learners generally have a self-concept of being responsible for their learning and need to be recognized as such in the learning environment. As stated by Lindeman in Knowles, "Adults have a deep need to be self-directing; therefore, the role of the teacher is to engage in a process of mutual inquiry with them rather than to transmit his or her knowledge to them and then evaluate their conformity to it." Their self-direction should be recognized and incorporated into the course design. For example, the course designer should assume that learners have goals that they bring to the environment and interest in engaging in the material in autonomous and self-directed ways. If the content is relevant to the participants, they will engage under their own volition.

Third, adult learners come to the learning environment with a wealth of personal experience and life experiences. From Lindeman in Knowles, “Experience is the richest resource for adults’ learning; therefore, the core methodology of adult education is the analysis of experience.” From these experiences they have developed mental models, or internal relations of how things work in a particular domain. As a result, they bring tremendous value to the learning environment because they know something about the content of the course. What they know may not always be correct but should be considered in the course design, as it is an important part of how they will incorporate course material into what they already know. In other words, “It assures that in any group of adults there will be a wider range of individual differences than is the case with a group of youths.” And that “Even more potent tools for raising the level of awareness of the need to know are real or simulated experiences in which the learners discover for themselves the gaps between where they are now and where they want to be.” The course designer should understand, to the degree possible, what participants know about the content and what they aspire to know by the end of the experience.

Fourth, adult learners’ orientation to learning is around problems or experiences, not around concepts or abstractions. “Adults are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems they confront in their life situations. Furthermore, they learn new knowledge, understandings, skills, values, and attitudes most effectively when they are presented in the context of application to real-life situations.” In addition, “Adults’ orientation to learning is life-centered; therefore, the appropriate units for organizing adult learning are life situations, not subjects.” Course content should be embedded in experiences that are common to the participants’ workplace. Participants want to take what they learn and be able to apply it to their jobs when they return to work, and they expect to leave the training with a sense of how they will do this. Course instructors should help participants envision this explicitly through course design, and participants should share their plans with how they will use their newly developed knowledge in their jobs, with the added benefit of other participants envisioning value of the content they had not recognized before hearing from others.

Finally, adult learners are intrinsically motivated and expect a payoff from the course content. The content needs to be relevant and useful to course participants. As stated by Lindeman in Knowles, “Adults are motivated to learn as they experience needs and interests that learning will satisfy; therefore, these are the appropriate starting points for organizing adult learning activities.” The course instructors should embed practices that help participants take ownership of their learning. For example, participants could describe how they will use the course content in their workplace and how they will continue to learn about the content from the course.

“Even dyed-in-the-wool pedagogical instructors have reported that their teaching became more effective when they adapted some of the andragogical concepts to the pedagogical model. Some ways they do this are by providing a climate in which the learners feel more respected, trusted, unthreatened, and cared about; by exposing them to the need to know before instructing them; by giving them some responsibility in choosing methods and resources; and by involving them in sharing responsibility for evaluating their learning” (Knowles et al., 2014).

Table 5-1 summarizes the key elements and example actions that can be taken by curriculum designers. As summarized by Knowles, “The andragogical instructor (teacher, facilitator, consultant, change agent) prepares in advance a set of procedures for involving the learners and other relevant parties in a process involving these elements: (1) preparing the learner; (2) establishing a climate conducive to learning; (3) creating a mechanism for mutual planning; (4) diagnosing the needs for learning; (5) formulating

program objectives (which is content) that will satisfy these needs; (6) designing a pattern of learning experiences; (7) conducting these learning experiences with suitable techniques and materials; and (8) evaluating the learning outcomes and re-diagnosing learning needs" (Knowles, et al., 2015).

Table 5-1 Summary of andragogy design elements and how to address them

Design Element	Ways to Address It
Adults are motivated to learn and expect a payoff	The content and focus of the course should align with the needs of the students. The instructor should understand these needs to the greatest extent possible prior to designing and implementing instruction.
Adults' orientation to learning is life centered, not concepts or abstractions	Instruction should incorporate cases, examples from the field, cases provided by participants.
Adult learners come with a wealth of experience	Instructors should elicit this experience from participants both before and during the course offering.
Adults need to be self-directing	Course participants should be active in the course and have a say in how the course goes so it meets their needs and takes advantage of their self-directing orientation. Mechanisms for mutual planning should be put in place.

It may be useful to align suggested activities in relation to stages of course implementation, as shown in the list below. These suggestions are also aligned with Adult Learning Theory. For example, all pre-course activities are aligned with understanding participants' backgrounds and expectations, and using case examples during the course will resonate with adult knowledge based on experiences.

- Before the course
    - Understand the learning expectations/desires.
    - Understand participants' backgrounds, as related to the course content.
    - Solicit ideas for course planning.
- During the course
    - Use case examples that highlight main ideas.
    - Engage participants with you, and with each other.
    - Rely on participants' knowledge and backgrounds.
- After the course
    - Did they fill their learning needs?
    - Do they use the content in their work?

Another perspective to consider when designing learning experiences for adults is how a pedagogical approach, commonly used in higher education, compares to an andragogical approach. Figure 5-1, copied from Knowles, highlights the differences. The key element in this comparison is that the adult learner must be considered and included holistically in the course design and evaluation. They have specific needs that they want to fill, and they want and need to be an actively considered in the design and implementation of the course, as noted in the quote below.

Process elements		
Element	*Pedagogical approach*	*Andragogical approach*
1. Preparing learners	Minimal	Provide information
		Prepare for participation
		Help develop realistic expectations
		Begin thinking about content
2. Climate	Authority-oriented	Relaxed, trusting
	Formal	Mutually respectful
	Competitive	Informal, warm
		Collaborative, supportive
		Openness and authenticity
		Humanness
3. Planning	By instructor	Mechanism for mutual planning by learners and facilitator
4. Diagnosis of needs	By instructor	By mutual assessment
5. Setting of objectives	By instructor	By mutual negotiation
6. Designing learning plans	Logic of subject matter	Sequenced by readiness
	Content units	Problem units
7. Learning activities	Transmittal techniques	Experiential techniques (inquiry)
8. Evaluation	By instructor	Mutual re-diagnosis of needs
		Mutual measurement of program

Figure 5-1 Comparison of pedagogical and andragogical approaches to course design and implementation (Knowles, et al., 2015)

"One aspect of educational practice that most sharply differentiates the pedagogical from the andragogical, the mechanistic from the organismic view, and moving from the teaching to the facilitating of learning perspective includes the role of the learner in planning. Responsibility for planning traditionally has been assigned almost exclusively to an authority figure (teacher, programmer, trainer). But this practice is so glaringly in conflict with the adult's need to be self-directing that it is a cardinal principle of andragogy (and, in fact, all humanistic and adult education theory). A mechanism should be provided for involving all the parties concerned in the educational enterprise in its planning. One of the basic findings of applied behavioral science research is that people tend to feel committed to a decision or activity in direct proportion to their participation in or influence on its planning and decision making" (Knowles, et al., 2015).

This section provides information on Adult Learning Theory from multiple perspectives, ranging from Figure 5-1 to the five tenets presented above. The purpose of doing so is to recognize that different instructors will understand and incorporate these ideas in different ways, and these examples provide different access points for doing so.

5.3 Participants' Backgrounds and Expectations

As noted from Adult Learning Theory, professional development courses are different from most college courses because their students have a variety of backgrounds and needs from the course. For example, a statics course has a relatively homogenous student population, and the content of statics is relatively static! College courses are normally part of a larger structured curriculum in which students progress from one course to the next. Professional development courses, even if part of a sequence, rarely have the same group of students progress through the sequence. Because of this, it is very important to understand the backgrounds of your audience and their hopes/expectations for what they will learn in your course.

This can be done by collecting data from the students in your class or from students who could take your class at some time. It is more effective to gather this information from students who take your course, because all participants have unique needs, and your students will be different from the general population. The suggested ideas and questions are shown in Table 5-2. The most efficient way to gather this information is to use an online survey tool, such as Qualtrics or SurveyMonkey. These questions will affect how structured the curriculum is and how you design interactive activities. For example, if everyone has a relatively common and limited knowledge base, then active learning pairings can be random, but if there is a wide variety of knowledge, then pairings should be strategic based on previous knowledge.

Table 5-2 Example questions on course participants' backgrounds and learning goals

Scope	Questions
Background	Who do you work for? What types of projects do you work on? How long have you been in your current job? In the profession?
Learning Goals and Relevant Knowledge	What do you expect to learn in this course? What experience do you have related to the content of this course? How do you expect to use what you learn in your work?

5.4 Establishing Course Goals, Outcomes, and Evaluation Measures

Armed with an understanding of the participants' backgrounds and needs, the first step in the design of any educational activity is to establish the goals and outcomes of the course and activities. These goals can come in a variety of forms and serve many constituents. For example, a new course on transportation safety offered to transportation professionals may have the goals of attracting participants, developing expertise, serving as the basis for future courses in related topics, being profitable, developing contacts among participants, etc. The developer should first articulate these goals and related outcomes as clearly as possible, so they can be explicitly considered in the course development process. This will allow the owner and the developer to understand the degree to which they were successful and to improve future course offerings.

The course goals and outcomes can be considered in three categories: the course goals, participant learning goals, and the teacher implementation goals, as noted in Table 5-3.

Table 5-3 Course goals with example outcomes and measures

Goal Category	Example	Outcome	Measure
Course goals	Attract participants from regional DOT offices	DOT employees participate	Number of participants
Participant learning goals	Students will learn about the Highway Capacity Manual	Student will be able to determine roadway capacities	Formative assessment during course where participants are asked to do this
Teacher implementation goals	Create an active learning environment	Students will engage with each other about course content	During course and/or End of course survey
	Incorporate participants' experiences	Students will share their relevant experiences with other students	

Participant learning goals should consider multiple levels of learning and comprehension and should consider Bloom's Taxonomy. Learning outcomes are specific measurable statements about what participants should be able to do after completing the course. Learning outcomes should use verbs from Bloom's Taxonomy (https://tips.uark.edu/blooms-taxonomy-verb-chart/) across the spectrum of cognitive difficulty. Specifically, Bloom's Taxonomy is a set of verbs assigned to categories that range from cognitively simple (Remember) to challenging (Evaluate or Create). Example outcomes are as follows:

The student will be able to

- Recall the sight distance equation
- Evaluate criteria used to determine sight distance.

A very rough approximation of the number of outcomes needed is one to four per hour of class time. Learning outcomes should be present in course documents, with the goal of maintaining focus and transparency with students about the intention of assessments and learning activities. For adult learning, they must also carefully consider and include the context of learning, with a focus on cases and stories. Specifically, "A statement of objectives should describe both the kind of behavior expected and the content or the context to which that behavior applies." As an example, a DOT engineer from Washington should learn about geometric design within the context of regional and statewide regulations through case examples from the appropriate regional area.

Teacher implementation goals should incorporate an evaluation of whether and how the needs of the learners are being addressed in the course. A core principle of adult learning is that the enrollees have specific needs that they want filled, and they desire for the knowledge gained to be worthwhile for their day-to-day work. "Here is the addition of a fifth dimension—one that springs directly from the fundamental conception of adult education as continuing education: re-diagnosis of learning needs. If every learning experience is to lead to further learning, as continuing education implies, then every evaluation process should include some provision for helping the learners re-examine their models" (Knowles, et al., 2015). Teachers can do so through formal and informal means throughout the course. For example, the teacher could ask the students if they are learning things that will be useful, and if not how the focus could be modified. This should also be included in an end of course survey.

5.5 Alignment of Learning Outcomes, Assessments, and Activities to Achieve Overall Course Goals

The learning outcomes are the core resource in curriculum design, particularly in adult education where participants have particular expectations of content. A focus on learning outcomes also requires the instructor to stay committed to what is considered important.

There are two well-developed and widely used approaches to curriculum development that begin with learning outcomes and that share a common approach. One is Constructive Alignment (Biggs, 1996) and the other is Backwards Design (Wigging and McTighe, 2005). Both focus on the alignment between goals and outcomes, assessment, and learning activities, and course development should occur in this order. This focus has many positive attributes, including having evidence of the degree to which goals and outcomes are met, forcing curriculum to support goals and outcomes, and developing clear measures of success.

The next step in the development process is to develop assessments that represent evidence that students are able to do the things described in the learning outcomes. In a college course, these would include quiz and exam questions. However, these types of assessments are rare in professional development courses. Instead, the focus is on developing formative assessments, or questions that can be used during the course to check in with students about their understandings. These formative assessments may include multiple choice, short answer, and open-ended questions. Course designers should develop two to five questions per learning outcome. These questions may not all be implemented, depending on the layout of the course. However, many should be implemented as formative assessments during the course. Formative assessments are those that are intended to gather feedback about what students know and used to make decisions about how and when to move to subsequent subjects.

The final step is to develop learning activities intended to facilitate student understanding of the developed learning outcomes. This consists of direct instruction using PowerPoint, notes, and other means. Information on developing these materials is not included in this document because most teachers will have substantial experience in this area.

Instructors should develop active learning activities that are used throughout the course. Active learning is when students are engaged alone or in groups on course content because of specific instructions provided by the instructor. Michelene Chi developed the ICAP theory, which suggests that interactive, constructive, active, and passive learning environments are decreasingly effective for student learning (Chi and Wylie, 2014). Interactive engagement is when students work in groups to work on a problem that would be challenging for any of them to solve on their own. In Adult Learning this may be particularly appropriate because it will result in information sharing among participants, allowing them to share their valuable and relevant experiences with others. Active learning and interactive engagement can take many forms, and there are many resources developed to guide instructors in their implementation.

5.6 Conclusion

The goal of this guidebook is to provide a summary of Adult Learning Theory and how it can and should inform design, implementation, and evaluation of professional development courses. Appendix C provides example interactive learning exercises and how to implement these in both in-person and online learning environments. Appendix D provides guidance on implementing active learning exercises and gathering student responses. Appendix E provides information on tools that can be used to engage students in online learning experiences. Appendix F provides a list of resources and descriptions of these resources that may be useful in course design, implementation, and evaluation. Appendix G provides some tips on engaging students in asynchronous learning environments.

5.7 References

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CHAPTER 6. FUTURE OPPORTUNITIES

In October 2023 PacTrans hired a new Assistant Director of Workforce Development to explore options to increase professional development and K-12 STEM learning opportunities. Several opportunities have been identified in collaboration with Region 10 PacTrans partners, including starting a Roads Scholars program in Washington state based on the successful efforts of the other states in the offering of this professional development program for road maintenance workers. Additional professional development opportunities have also been identified by Region 10 partners on topics including worker safety, using AI for transportation planning, data security for transportation agencies in light of AI, educating front-line transportation workers and professionals on the updated MUTCD, and integrating pedestrian and bike safety measures in the development of complete streets in active transportation planning. All Region 10 DOTs have been contacted and are interested in learning more about how to collaborate to offer online and regional learning opportunities.

PacTrans is currently connecting with K-12 STEM outreach programs in regional campuses to better understand their priorities and how we can collaborate to train and recruit the next generation of transportation professionals. We seek to leverage existing partnerships that these programs have with local K-12 schools to connect students with engaging learning opportunities. PacTrans is putting particular emphasis also on creating partnerships and connecting with first generation and tribal student communities to provide opportunities for building a more diverse and inclusive workforce.

6.1. Professional Continuing Education

In the last five years the transportation industry has seen a transformation in the skills and technologies needed to provide high quality transportation engineering, planning, and services. Online professional development opportunities have flourished, while in-person opportunities are returning to a post pandemic workforce. PacTrans is currently analyzing the professional development landscape to understand what opportunities exist at the national, regional, and state levels. PacTrans will prioritize developing new professional development courses that are non-duplicative and unique to addressing current transportation workforce needs.

6.2. K-12 STEM Outreach

The K-12 Transportation Summer Camp program was very successful in its first year. The program is being expanded this year, with plans for future continuation. Region 10 university partners are also planning to develop online courses and outreach materials for the K-12 audience to increase awareness of transportation engineering. Region 10 university partners are looking to collaborate with existing programs that work with K-12 schools to increase awareness and access to engineering education for first generation college students.

6.3. Tribal Transportation Workforce

A disproportionate amount of traffic safety incidents occur on roads in tribal communities. As part of the Northwest Tribal Technical Assistance Program (NW TTAP) (at the University of Washington) staff have met with 47 tribal entities this year to better understand their transportation needs. Currently in development are programs to increase transportation safety on tribal lands, educate tribe staff, and increase collaboration to better serve tribal communities.

6.4. Conclusion

PacTrans recognizes the outsized need of transportation industry professionals to maintain and upgrade their professional skills. The PacTrans Workforce Development Institute is working collaboratively with university and industry partners to identify priority workforce development needs and provide solutions. Influenced by current research and stakeholder training needs, the PacTrans WDI is currently identifying priority professional development training that will be offered by the Institute.

Current research indicates that transportation industry professionals understand the need for additional training to maintain their professional skills as the industry changes over time in response to climate justice, technology changes, human behavior, and policy updates. The PacTrans WDI will serve as an educational hub for organizations and professionals who understand the need and are looking to support innovative transportation professional development.

Key challenges to attending a training are recurrent in research and feedback from partners. Addressing these challenges—which include support from supervisors to attend training, the location of training, and total cost (inclusive of travel) of trainings—is at the forefront as PacTrans sets programmatic goals for the Workforce Development Institute. Staff and supervisors have also shared that a congruence between training and upcoming work is a key driver in decision making related to attendance. While online education can be less expensive, in-person training where employees learn new skills is highly valued by employees.

It can be said that there have been more changes to the transportation industry in the last five years than in the previous 50 years combined. This presents a significant challenge to our daily commute and our national security. The Workforce Development Institute is working with partners to identify strategic workforce development goals for the next five years while offering just-in-time learning opportunities in collaboration with stakeholders as a strategic plan comes together. PacTrans is actively engaging industry partners to help identify short- and long-term goals for the WDI. The hope is that collectively we can address current and future transportation workforce needs.

APPENDIX A. MANAGER SURVEY SUMMARY REPORT

Q4 - In which sector of transportation engineering do you work?

#	Answer	%	Count
1	Public	84.13%	53
2	Private	14.29%	9
3	Other:	1.59%	1
	Total	100%	63

Other:

Other: - Text
State Government

Q7 - What is the region in which your work applies (e.g., zip code, town, municipality)

What is the region in which your work applies (e.g., zip code, town, municipality)
Based in Juneau Alaska; responisble for Southcoast Region (SE AK, Aleutians, Kodiak, Lake and Penisula Borough)
Southcoast Region
Alaska
Northwest 979229
99901
Alaska
Southeast Alaska
99507
State of alaska
Southeast Alaska
99502
99502
Anchorage, Alaska 99501
99811
Municipality of Anchorage, Anchorage, Alaska
99701
Municipality of Anchorage
99801
99507, Anchorage, AK
Alaska DOT Northern region ~ 65% of the state
99507
Municipality of Anchorage, Alaska
Fairbanks, Western, and Northern Alaska
99801
Alaska
All Alaska
Southcoast (zip code 99801)

Anchorage Alaska
Alaska
99708
99503
ODOT Region 1
97266
Salem Oregon
98109
Oregon
Sacramento, CA 95814
Seattle, WA
Sacramento CA
King County, WA
Portland
Seattle
98040
97301
Pullman, Washington
98004
98004
98004
98006
Washington State
99709
99709
State of Alaska
Fairbanks, AK 99709
99709
99701

Northern Region og Alaska
99709
State of Alaska, Northern region
Fairbanks, AK 99709
99709
99709

Q5 - How long have you been working in the field of transportation engineering?

#	Answer	%	Count
1	less than 1 year	0.00%	0
2	1-2 years	0.00%	0
3	3-5 years	3.17%	2
4	more than 5 years	96.83%	61
	Total	100%	63

Q6 - How long have you been working in your current position?

#	Answer	%	Count
1	less than 1 year	11.11%	7
2	1-2 years	17.46%	11
3	3-5 years	19.05%	12
4	more than 5 years	52.38%	33
	Total	100%	63

Q8 - Which area or discipline best describes your work (check all that apply)?

#	Answer	%	Count
1	Traffic	17.81%	26
2	Highway	18.49%	27
3	Safety	10.96%	16
4	Construction	13.70%	20
5	Design	21.92%	32
6	Consulting/Inspection	6.85%	10
7	Other	10.27%	15
	Total	100%	146

Other

Other - Text
Marine Engineering and Project Management
Bridge
Heavy civil construciton contract administration
ROW
Bridges and structures
utilities
Travel Modeling
Project Management
Planning
Operations
Research
Aviation / FAA
Hydraulics
Utilities/ROW
geotechnical

Q9 - How many employees do you supervise?

#	Answer	%	Count
1	1-3	19.05%	12
2	4-6	33.33%	21
3	7-10	14.29%	9
4	10+	33.33%	21
	Total	100%	63

Q10 - On average, how many times does a typical employee attend external training within a year?

#	Answer	%	Count
6	0	23.81%	15
1	1	33.33%	21
2	2	31.75%	20
3	3	6.35%	4
4	4	4.76%	3
5	5 or more	0.00%	0
	Total	100%	63

Q11 - On average, how many times does a typical employee attend internal training within a year?

#	Answer	%	Count
1	1	19.05%	12
2	2	15.87%	10
3	3	22.22%	14
4	4	11.11%	7
5	5 or more	31.75%	20
	Total	100%	63

Q12 - How do you typically find out about training opportunities?

#	Answer	%	Count
1	Internal communications	33.56%	50
2	Email listserv	16.78%	25
3	Word of mouth	15.44%	23
4	Online advertising	10.74%	16
5	Professional socieites	18.79%	28
6	Other	4.70%	7
	Total	100%	149

Other

Other - Text
Web
All the above
Local consultant engineers
old fashion us mail
email and DOT website
NHI website
mailed flyers

Q13 - How important are the following kinds of training for employees in your workplace?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Professiona l Skills	31.75%	20	44.44%	28	23.81%	15	0.00%	0	0.00%	0	63
2	Technical Skills	50.79%	32	44.44%	28	4.76%	3	0.00%	0	0.00%	0	63
3	Updates on rules and regulations	30.16%	19	44.44%	28	20.63%	13	3.17%	2	1.59%	1	63
4	Other:	60.00%	6	30.00%	3	0.00%	0	10.00%	1	0.00%	0	10

Other:

Other: - Text
Communication skills
Safety
New Technologies
Internal cross-training
people skills
Fed-Aid program requirements
Planning
Computer Modeling
Emerging topics
People/Communication skills
Soft Skills (Communication, Leadership, etc.)

Q15 - How important are the following factors when deciding to send an employee to a particular training?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Location	37.10%	23	37.10%	23	20.97%	13	3.23%	2	1.61%	1	62
2	Cost	42.86%	27	31.75%	20	17.46%	11	7.94%	5	0.00%	0	63
3	Employee time off	9.84%	6	14.75%	9	45.90%	28	13.11%	8	16.39%	10	61
4	Topic area	54.10%	33	44.26%	27	1.64%	1	0.00%	0	0.00%	0	61
5	Timeliness of training to an upcoming job	16.13%	10	33.87%	21	33.87%	21	11.29%	7	4.84%	3	62
6	Networking opportunities	4.84%	3	11.29%	7	43.55%	27	27.42%	17	12.90%	8	62
7	Professional development (e.g., leadership)	14.52%	9	45.16%	28	22.58%	14	14.52%	9	3.23%	2	62
8	Other	33.33%	1	33.33%	1	0.00%	0	0.00%	0	33.33%	1	3

Other

Other - Text
Safety
Wide technical skills

Q16 - How important are the following topics in terms of timeliness of training needs?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Performance monitoring/Signal systems	11.29%	7	19.35%	12	30.65%	19	16.13%	10	22.58%	14	62
2	Accessibility and ADA compliance	19.35%	12	30.65%	19	32.26%	20	12.90%	8	4.84%	3	62
3	Changes in technology	11.11%	7	38.10%	24	44.44%	28	4.76%	3	1.59%	1	63
4	Design	20.63%	13	38.10%	24	30.16%	19	11.11%	7	0.00%	0	63
5	Transportation Systems Management and Operations	8.20%	5	21.31%	13	36.07%	22	24.59%	15	9.84%	6	61
6	Connected or autonomous vehicles	6.45%	4	9.68%	6	27.42%	17	16.13%	10	40.32%	25	62
7	ITS Design and application	3.33%	2	20.00%	12	35.00%	21	20.00%	12	21.67%	13	60
8	Other:	68.75%	11	25.00%	4	0.00%	0	0.00%	0	6.25%	1	16
9	Other:	50.00%	2	50.00%	2	0.00%	0	0.00%	0	0.00%	0	4
10	Other:	100.00%	2	0.00%	0	0.00%	0	0.00%	0	0.00%	0	2

Other:

Other: - Text
Communication with non-professionals
ROW Acquisition
AASHTOWare
structures
Public Involvement /Speaking
Active Transportation
Construction administration
Federally mandated Bridge Inspection
Construction related

Planning
Pavements
Non motorized design
Professional development for new/prospective managers
Claims and Negotiations
Utility relocations/permits
geotechnical

Other:

Other: - Text
NEPA
Writing Skills
Bridges
Construction Administration

Other:

Other: - Text
Contract Admin
Soft Skills / Communication, etc.

Q18 - Please rate your preference for the following training formats.

#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	On-site training with external presenter	30.16%	19	50.79%	32	17.46%	11	0.00%	0	1.59%	1	63
2	Live, online courses (e.g., webinars)	11.11%	7	39.68%	25	34.92%	22	12.70%	8	1.59%	1	63
3	Asynchrono us, online short courses	0.00%	0	38.71%	24	41.94%	26	19.35%	12	0.00%	0	62
4	External training or other off-site programs	9.68%	6	53.23%	33	32.26%	20	4.84%	3	0.00%	0	62
5	Conferences or other large meetings	9.52%	6	36.51%	23	49.21%	31	4.76%	3	0.00%	0	63
6	Other:	83.33%	5	16.67%	1	0.00%	0	0.00%	0	0.00%	0	6

Other:

Other: - Text
college classroom style
University-based short courses with homework
On site, live training
On-site training with internal presenter
On-site training with INTERNAL presenter (i.e. Peer Sharing)

Q19 - Please rate your preference regarding the timing of training opportunities.

#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	During normal work hours	66.67%	42	31.75%	20	1.59%	1	0.00%	0	0.00%	0	63
2	During weekends	0.00%	0	5.08%	3	10.17%	6	52.54%	31	32.20%	19	59
3	Evenings	0.00%	0	5.08%	3	20.34%	12	49.15%	29	25.42%	15	59
4	Other:	25.00%	1	25.00%	1	50.00%	2	0.00%	0	0.00%	0	4

Other:

Other: - Text
Small group: peers/multidiscipline
Between the months of October - April

Q14 - Which factors are the biggest limitations or drawbacks to training programs?

#	Answer	%	Count
1	Time off	10.09%	11
2	Covering for employees	10.09%	11
3	Training contents do not match needs	32.11%	35
4	Too much theory, not enough practice	22.02%	24
5	Employee leaves for new job after training	8.26%	9
6	Other	17.43%	19
	Total	100%	109

Other

Other - Text
COST (x 7 responses)
Travel and Per diem Cost
Long weeks. Usually done while keeping up with work.
Not new information
Lack of funds.
no training money
Gauging how effective the training will be ahead of time
Not enough homework which is really needed to acquire / learn new material
travel cost
Availability when needed (just in time training)
Available funds
Lack of funding, remote location makes travel expensive and hard to get classes brought here.
no funding available for training

Q17 - Are there any topics for which you would like training but that are not currently available or personally accessible?

Are there any topics for which you would like training but that are not currently available or personally accessible?
We have the ability to request specific training as needed - so no.
Office Engineering practices
Innumerable
Highway Construction Specification development
Communication skills with non-professionals (average citizens/laypersons). Management of small teams
No
no
No.
Construction Administration Software in general
No
Federal, State, and Local Funding 101 for Projects (Design thru Construction)
unknown
Utility training, railroads, fiber optic
No
An periodical overview of 'what's new' would be very helpful.
Hydraulic Engineering Topics
Autonomous Vehicle Implications
Asphalt paving, bridge, retaining wall (construction or contract admin based)
No
data storytelling
Nope
Systems Operations Documents for Adaptive Signal Networks
no
Multimodal transportation
no
why is there a silly war on cars and a hatred of freeways?

Technician training -- most training focuses on engineering employees
Connected Vehicles
NACTO and Vision Zero
Construction's input on lesson's learned - big picture - what to look for when designing or reviewing projects?
no
Leadership, managing resources
skip tracing and archive research
No
Needs to be more training for utility coordination and relocation. More training on the applicable state laws and how they interact with FHWA/FAA regulations.
aviation base training - covering AC's

APPENDIX B. ENGINEERING PRACTITIONER SURVEY REPORT

Q20 - In which sector of transportation engineering do you work?

#	Answer	%	Count
1	Public	92.56%	112
2	Private	4.96%	6
3	Other:	2.48%	3
	Total	100%	121

Other:

Other: - Text
N/A
academia

Q21 - In which zip code do you conduct most of your work?

In which zip code do you conduct most of your work?
99500
T2M1M3
98005
99801
99709
98009
99508
99519
97301
99518
99503
99501
99701
99709
99780
99508
99503
99801
99925
99833
99508
99519
99503
97210
Statwide
Various, by county would be Lincoln, Benton, Lane, Polk, Yamhill, and Marion
97470

97302
972xx
83709
97302
98516
98004
97850
97209
97301
97301
97301
98057
97209
97302
97471
97301
97301
97301
98004
97333
Jackson, Josephine, Coos Curry and Douglas Counties Equally
97527
97301
97302
98004
97209
97302
97850
97302

97301
92501
98004
Norway
98155
97330
83703
83844
97205
98004
98004
98004
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98004
98005
98008
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98004
98009
98004
98009
99762
99709
97302
97701
97301
97306

99701
99709
97302
99701
97301
99709
97301
97302
99707
99712
99709
97302
97703
97703
97703
97302
97302
97302
97302
99701
99711
99712
99709
99709
99730
99709
99709
99701
99701

99709
99709
99709
99701
99708

Q22 - How long have you been working in the field of transportation engineering?

#	Answer	%	Count
1	less than 1 year	4.20%	5
2	1-2 years	7.56%	9
3	3-5 years	10.08%	12
4	more than 5 years	78.15%	93
	Total	100%	119

Q23 - How long have you been working in your current position?

#	Answer	%	Count
1	less than 1 year	22.50%	27
2	1-2 years	18.33%	22
3	3-5 years	16.67%	20
4	more than 5 years	42.50%	51
	Total	100%	120

Q24 - Which area or discipline best describes your work (check all that apply)?

#	Answer	%	Count
1	Traffic	14.56%	38
2	Highway	20.31%	53
3	Safety	11.49%	30
4	Construction	13.03%	34
5	Design	21.46%	56
6	Consulting/Inspection	6.90%	18
7	Other	12.26%	32
	Total	100%	261

Other

Other - Text
Planning
Planning
Planning
Policy
Maintenance and Operations
Maintenance and Operations
Active Transportation
Civil Rights and Realty
Audit
Survey
Survey
bridge
Human Resources
Roadway
Technology Development

Right of Way
Environmental permitting
Data Management
Hydraulics
Permitting
Asset Management
Load rating
Communications
Research
Research
Planning
fuels and materials
Locations Surveyor
Admin
Utilities (Highways)
ROW
Utilities

Q26 - On average, how many times do you attend external training within a year?

#	Answer	%	Count
6	0	24.19%	30
1	1	33.06%	41
2	2	22.58%	28
3	3	8.06%	10
4	4	3.23%	4
5	5 or more	8.87%	11
	Total	100%	124

Q27 - On average, how many times do you attend internal training within a year?

#	Answer	%	Count
6	0	5.65%	7
1	1	16.13%	20
2	2	22.58%	28
3	3	16.94%	21
4	4	13.71%	17
5	5 or more	25.00%	31
	Total	100%	124

Q28 - How do you typically find out about training opportunities?

#	Answer	%	Count
1	Internal communications	37.55%	98
2	Email listserv	19.92%	52
3	Word of mouth	14.94%	39
4	Online advertising	8.43%	22
5	Professional socieites	17.24%	45
6	Other	1.92%	5
	Total	100%	261

Other

Other - Text
Internal website
Searching
Dept. Training website
Ilearn

Q36 - How common are the following methods in discovering training opportunities?

#	Question	Very common		Somewhat common		Neutral		Somewhat uncommon		Very uncommon		Total
1	Internal email listserv	42.61%	49	28.70%	33	18.26%	21	5.22%	6	5.22%	6	115
2	Professional society	23.48%	27	28.70%	33	21.74%	25	10.43%	12	15.65%	18	115
3	Word of mouth	14.91%	17	37.72%	43	23.68%	27	18.42%	21	5.26%	6	114
4	Suggestion from manager or supervisor	21.01%	25	46.22%	55	14.29%	17	12.61%	15	5.88%	7	119
5	Online advertising	6.03%	7	25.86%	30	24.14%	28	22.41%	26	21.55%	25	116
6	Other	26.09%	6	4.35%	1	52.17%	12	8.70%	2	8.70%	2	23

Other

Other - Text
Twitter, LinkedIn, Facebook
Internal website
Searching
ept Training website
Search the internet
Twitter/Advocacy
internal publications
School announcements

Q37 - How common are training opportunities related to the following topics or content areas?

#	Question	Very common		Somewhat common		Neutral		Somewhat uncommon		Very uncommon		Total
1	Gaining new technical skills	18.85%	23	47.54%	58	19.67%	24	8.20%	10	5.74%	7	122
2	Updates on regulations	17.36%	21	45.45%	55	20.66%	25	13.22%	16	3.31%	4	121
3	Professional development or leadership	27.05%	33	36.07%	44	19.67%	24	10.66%	13	6.56%	8	122
4	Networking	7.63%	9	22.88%	27	33.90%	40	21.19%	25	14.41%	17	118
5	Other:	0.00%	0	0.00%	0	72.73%	8	9.09%	1	18.18%	2	11

Other:
Other: - Text

Q29 - How important are the following kinds of training for employees in your workplace?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Professional Skills	31.93%	38	44.54%	53	16.81%	20	6.72%	8	0.00%	0	119
2	Technical Skills	58.33%	70	31.67%	38	10.00%	12	0.00%	0	0.00%	0	120
3	Updates on rules and regulations	48.33%	58	36.67%	44	13.33%	16	1.67%	2	0.00%	0	120
4	Other:	50.00%	5	0.00%	0	40.00%	4	0.00%	0	10.00%	1	10

Other:

Other: - Text
Certification Training
networking
Advancement Skills
PDH's/CEUs

Q30 - How important are the following factors when deciding to attend a particular training?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Location	33.88%	41	42.98%	52	16.53%	20	4.13%	5	2.48%	3	121
2	Cost	38.33%	46	27.50%	33	24.17%	29	5.83%	7	4.17%	5	120
3	Employee time off	13.56%	16	17.80%	21	33.05%	39	18.64%	22	16.95%	20	118
4	Topic area	45.83%	55	39.17%	47	14.17%	17	0.83%	1	0.00%	0	120
5	Timeliness of training to an upcoming job	7.44%	9	32.23%	39	38.02%	46	12.40%	15	9.92%	12	121
6	Networking opportunities	2.48%	3	17.36%	21	22.31%	27	38.02%	46	19.83%	24	121
7	Professional development (e.g., leadership)	11.57%	14	37.19%	45	29.75%	36	15.70%	19	5.79%	7	121
8	Other	37.50%	3	0.00%	0	37.50%	3	0.00%	0	25.00%	2	8

Other

Other - Text
PDH
Training budget available
Relevance
Nepotism / Favoritism

Q31 - How important are the following topics in terms of timeliness of training needs?

#	Question	Extremely important		Very important		Moderately important		Slightly important		Not at all important		Total
1	Performance monitoring/Signal systems	6.84%	8	22.22%	26	30.77%	36	21.37%	25	18.80%	22	117
2	Accessibility and ADA compliance	25.00%	30	34.17%	41	19.17%	23	10.00%	12	11.67%	14	120
3	Changes in technology	19.01%	23	44.63%	54	25.62%	31	6.61%	8	4.13%	5	121
4	Design	25.00%	30	43.33%	52	20.00%	24	5.83%	7	5.83%	7	120
5	Transportation Systems Management and Operations	15.00%	18	35.83%	43	26.67%	32	13.33%	16	9.17%	11	120
6	Connected or autonomous vehicles	5.83%	7	19.17%	23	20.83%	25	20.00%	24	34.17%	41	120
7	ITS Design and application	4.27%	5	23.93%	28	31.62%	37	19.66%	23	20.51%	24	117
8	Other:	68.75%	11	25.00%	4	0.00%	0	0.00%	0	6.25%	1	16
9	Other:	42.86%	3	28.57%	2	0.00%	0	0.00%	0	28.57%	2	7
10	Other:	20.00%	1	20.00%	1	20.00%	1	0.00%	0	40.00%	2	5

Other:

Other: - Text
Safety, walking, cycling
Regulation updates
Sustainable Products
Environmental implications
Auditing AASHTO
Survey/LiDar
Engineering Geology
Don't Know
Funding Regulation and Compliance
Work zones

Highway Safety and applications to those identified above
Arctic Design
Uniform Act
Accountability

Other:

Other: - Text
Active Transportation
Regulatory oversight
Geotechnical Engineering
Project Management
Ethics

Other:

Other: - Text
Public Involvement
Contract Administration

Q32 - Please rate your preference for the following training formats.

#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	On-site training with external presenter	41.18%	49	46.22%	55	10.92%	13	1.68%	2	0.00%	0	119
2	Live, online courses (e.g., webinars)	17.65%	21	43.70%	52	26.89%	32	9.24%	11	2.52%	3	119
3	Asynchronous, online short courses	11.02%	13	32.20%	38	39.83%	47	16.10%	19	0.85%	1	118
4	External training or other off-site programs	17.65%	21	51.26%	61	25.21%	30	5.04%	6	0.84%	1	119
5	Conferences or other large meetings	18.49%	22	38.66%	46	31.93%	38	8.40%	10	2.52%	3	119
6	Other:	42.86%	3	0.00%	0	42.86%	3	0.00%	0	14.29%	1	7

Other:

Other: - Text
internal training with internal staff
WTH is Asynchronous?
Self Study
Classroom training through university

Q33 - Please rate your preference regarding the timing of training opportunities.

#	Question	Highly desirable		Desirable		Neutral		Undesirable		Highly undesirable		Total
1	During normal work hours	66.12%	80	28.93%	35	4.96%	6	0.00%	0	0.00%	0	121
2	During weekends	2.48%	3	5.79%	7	14.88%	18	40.50%	49	36.36%	44	121
3	Evenings	4.17%	5	7.50%	9	24.17%	29	41.67%	50	22.50%	27	120
4	Other:	0.00%	0	40.00%	2	40.00%	2	0.00%	0	20.00%	1	5

Other:

Other: - Text
on the web to gain knowledge like a tedX talk
Vacations

Q34 - Which factors are the biggest limitations or drawbacks to training programs?

#	Answer	%	Count
1	Time off	16.26%	33
2	Covering for employees	8.37%	17
3	Training contents do not match needs	33.50%	68
4	Too much theory, not enough practice	23.15%	47
5	Employee leaves for new job after training	5.42%	11
6	Other	13.30%	27
	Total	100%	203

Other

Other - Text
Not enough ongoing training in a laid-out format
Training budget
Employer denies opportunity
Cost of travel to attend and lack of, or prerequesites for online courses
budget restraints
Cost
Scarcity
Work deversity makes trainning often silly... I use little of my degree let alone a short professional course
No $s set aside for training.
knowledge of whats available
Certification training preferred over formal education
training efficiency, workload, convenience
Cost
Limited location, inability to travel out of state to attend
Current workload
Not very many opportunities offered and those that are offered are repetative.

Too much paper work to apply to attend training outside and inside the State. Please symplify the process!
at 60 years less training
Conflicts with deadlines or other applicable trainings
Lack of employer support for external or out-of-town/State training opportunities that require ANY travel.
associated cost of training
Location
Cost
funding
Immediate Application (knowledge loss after training)
agency funding
Cost

Q35 - Are there any topics for which you would like training but that are not currently available or personally accessible?

Are there any topics for which you would like training but that are not currently available or personally accessible?
Complete streets, equity, walking and cycling
not at the moment
Linkage between Planning, Programming and Project Development
AASHTO Geometric Design
Aviation
Regulatory environmental compliance all topics
Drainage design, hydraulic modelling, fish passage culvert design.
No
N/A
no
thanks
No
AASHTO 48 CFR 31.2
general web based training like TedX talks.
N/A
leadership skills, PEOPLE management skills
Training on our guidance documents, manuals and applicable laws, such as the Oregon Highway design manual, bike bill, the Oregon Bike and Pedestrian Plan. Actual human scale design training for roadway designers. Land use concepts for roadway designers. Multimodal transportation creative design courses.
Northwest Geotechnical Workshop, Highway Geology Symposium
How to make your boss care about his/her employees? Should we develop EIT or continue to burn them out and make them cynical mutes.
3D CAD and/or structural (bridge) BIM
unknown
No.
Advanced ArcGIS, Python, Visual Basic
Yes. External training is not normally allowed because of 1) no funding for training, 2) statewide travel bans for State employees that are not in upper management, 3) Agency concern regarding "public perceptions"
no

Roundabouts and Urban Ped and Bike design
No
ArcGIS Online
Hydraulics
computer programs related to my position
PE Exam Review
no
no
no
PowerPoint skills
No
no
None
NA
n/a
Efficient Communication, dealing to high-maintenance team members
Federal administration of contracts, including requirements for specifications.
fiber networking basics
field applications
structural pole information, base design, signal design
electric vehicles as it relates to infrastructure planning, urban design as it relates to engineering design and project performance, franchise utility infrastructure planning, property acquisition processes and federal guidelines, impacts of autonomous vehicles and 5G technologies integrated into public infrastructure
no
N/A
NO
Advanced training classes for ArcGIS, C3D. Classes for career advancement such as PE/FE Exam study workshops.
no
How to incorporate safety culture in Oregon.
Corsim, QuickZone

Hands on s UAV training and CIVIL3D course
no
no
Practical ADA course (with standard applications and lots of exceptions to standard situations)
Not that I can think of
Infraworks
ADA Design for Temporary Traffic Control
Team Building, Change Management
Trainings related to hydraulics.
3D, 4D and 5D Construction Visualizations and Time vs. Cost Constructability Models
Additional transportation safety training, statistical training and applications to safety,
ArcGIS or similar, Adobe forms or similar form building software,
n/a
none
No
n/a
Right of Way
No
Hydrology, hydraulics, climate impact resiliency
Design considerations for low volume, permafrost/discontinuous permafrost/warm permafrost, or other non-standard conditions
Utility Design for state agencies dealing with Utility relocates by others.
GIS training
no
No
No

APPENDIX C. INTERACTIVE LEARNING EXAMPLES

1. Minute Paper

Brief Description

The Minute Paper is a classroom assessment technique that is used by instructors to gain feedback from students on their understanding of course material. The assessment tool can be beneficial for instructors because students are asked to provide feedback by self-reflecting on their learning as opposed to simply recalling facts that were learned in lecture. This added dimension can provide valuable feedback while only using minimal class time.

To administer the Minute Paper technique, the instructor asks the class to write down their responses to two main questions after a lecture or section of material has been covered: (1) what was the most important thing(s) you learned during this lesson? (2) what important question(s) remains unanswered? The instructor then collects the written responses from the students and uses them to evaluate the students understanding of main topics and discover the parts of the lesson where they struggled. This provides the instructor with feedback that can help improve the course material and inform them on topics that could use more lecture time. An important benefit for students is this assessment gives them an opportunity to bring up questions that they might not have asked otherwise, and hopefully get those questions answered by the instructor in the beginning of the next lecture. This timely feedback helps students follow the future lecture material more clearly since they are given the chance to clarify important concepts before moving on to new lecture material.

Resources List

Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 148-153

How to Implement in Person and in Zoom

Refer to the section on "Administering Teaching Techniques and Collecting Responses" for some general guidelines on written response questions. Located below are some helpful tip specific to this classroom assessment technique:

- Administer the Minute Paper written response questions after a section where students learn a significant amount of new information. This is typically after an information dense lecture or series of lectures, but can also include assigned reading, educational video, etc.
- The two main questions presented in the brief description above can be personalized to better align with the instructors needs.
- Provide feedback on the student responses during the start of next lecture or as quickly as possible. The feedback should include answering some of the most common student questions and helping students distinguish between main points and minor details.

2. Muddiest Point

Brief Description

The Muddiest Point is a classroom assessment technique that instructors can use to evaluate student learning from a lecture, reading assignment, discussion, or any other learning opportunity. Students are asked to reflect on their learning and give written input on the information they struggle to understand. With this immediate feedback, the instructor can make informed decision on how to improve their future lectures and assignments.

To implement the technique, the instructor asks the class to write down their "muddiest" point from the information they just learned. In other words, what did the student find unclear, confusing, or difficult to understand from the information presented in the lesson. The instructor uses this student feedback as an opportunity to improve their future lesson plans as well as provide clarity to the students on the confusing aspects of the lesson. The students benefit from the instructor feedback on common issues that the instructor chooses to address.

Resources List

Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 154-158

How to Implement in Person and in Zoom

Refer to the section on "Administering Teaching Techniques and Collecting Responses" for some general guidelines on written response questions. Located below are some helpful tip specific to this classroom assessment technique:

- It is best to ask about the "muddiest" point at the end of a lesson or activity where students learn a significant amount of new information.
- Once you collect all the responses, read through them, and look for common issues that students are reporting from the information they learned.
- Use the feedback from students to put together some clarifying comments for the beginning of the next lesson or provide some other response to address the students' confusion (send out an email with clarifying comments and additional learning resources, make a quick Khan Academy style video, etc.). Also use this feedback to improve your lesson plan for future courses.

3. Update Your Classmate

Brief Description

Update Your Classmate is an active learning technique to help students recall information from previous lessons and anticipate how that learned knowledge will connect to the upcoming lesson. The process of recalling the most important topics and predicting how they will connect with new information can be an effective way of engaging a student at the start of a lecture.

To begin implementing the technique, at the beginning of a new lesson each student is asked to write out a summary of the main points from the previous lesson to a fictional student who missed class. Then each student is asked to explain how the information that the absent student missed in the previous lesson will be connected to the upcoming lesson. The two written responses are collected and can be quickly graded. Instructors should look for basic recollection of main lecture points and logical predictions for how the learned information connects to new information. The intended benefit for students participating in this writing exercise is to help them recall information from previous lessons and prime their brain to make connections with new lecture material. They also get practice using their prediction skills by creating a hypothesis for how the material in each lesson will connect to each other and actively refining their predictions as new material is presented.

Resources List

- Textbook – Interactive Lecturing: A Handbook for College Faculty by Elizabeth F. Barkley and Claire Howell Major. Pg 217-220
- https://kpcrossacademy.org/techniques/update-your-classmate/

How to Implement in Person and in Zoom

Refer to the section on "Administering Teaching Techniques and Collecting Responses" for some general guidelines on written response questions. Located below are some helpful tip specific to this active learning technique:

- Typical format for the two question in the memo to the absent student: (1) Write a short summary of the 2-4 main points from the previous lesson? (2) How will the information learned in the previous lesson be connected/useful to the upcoming lesson?
- If you would prefer to not use classroom time, try send an email with the Google Form link out to all the students during the morning of the day of the lecture and tell students to write responses to the two question in the Google Form before class starts. Then begin class going over some of the successful student responses.
- This technique can be presented as an ongoing journal activity instead of a single memo written to a fictional student who missed class. This gives the student an ongoing cycle of recalling old information and prediction connections to new information that could be beneficial for learning.
- Instructors can review the written responses after the lecture to get a sense of the student understanding of the class material.

4. Background Knowledge Probe

Description

The Background Knowledge Probe is a classroom assessment technique that instructors can use to gain insight into students' knowledge before classroom instruction begins. The feedback gained from this assessment can provide the instructor with information that can lead to adjustments to their course content and future lesson plans.

This assessment technique is implemented at the beginning of a course or section of course content. The instructor puts together a quiz based on a mixture of material that the students are expected to learn in the course and some information they might already know. The questions are generally multiple choice, fill in the blank, and short answer, but the style of questions can be adjusted any way the instructor believes will reveal the depth of each student's knowledge. Once the quiz is put together by the instructor, it is administered to the students and collected for evaluation. Results from the quiz can be used by the instructor to make decision on adding or reducing instructional time given to specific subjects or adding assignments that allow students to increase their knowledge base. Presenting the results to the class and going over common misconceptions exposed by the quiz can help students know where the class knowledge stands and where they fit in relative to their peers. The students can increase their preparation for the course in accordance with how they performed.

Resources List

Textbook - Classroom Assessment Techniques: A Handbook for College Teachers 2nd edition by Thomas A. Angelo and K. Patricia Cross. Pg 121-125

How to Implement in Person and in Zoom

Refer to the section on "Administering Teaching Techniques and Collecting Responses" for some general guidelines on multiple-choice/survey questions. Located below are some helpful tip specific to this classroom assessment technique:

- A helpful tip for instructors writing questions is to have at least one question easy enough for everyone to answer and one difficult enough that no one can answer. The goal is to get each student on the scale and have no one tipping over either side. Some concepts should be review and some should be new.
- An important part of analyzing quiz results is to present the results to the class as soon as possible. The instructor should give the group a sense of where the average class knowledge is currently at (what concepts could most students answer), correct any commonly held misconceptions on questions, and give students a sense of where their knowledge base resides relative to their classmates.
- For students who performed poorly on the knowledge probe, encourage them to allocate more of their time to studying this course because this material will be comparatively new. For the students who performed above average, encourage them to help other students with understanding concepts.
- Style of questions for the knowledge probe: multiple-choice and fill-in-the-blank questions to gage basic understanding of content, Short-answer and open-ended questions to gage deep understanding of content.

5. Think-Pair-Share

Description

Think-Pair-Share is an active learning technique used to get students actively engaged and participating in class discussions and problem-solving exercises. This technique gives students an opportunity to measure their understanding and ideas with their peers.

To implement this technique during a lesson, the instructor asks a question or presents a problem for the students to think about, pairs the students up, and tells them to share their response to the question with an assigned partner. Then the instructor brings the whole class back together and asks for a few students to share their rehearsed responses to facilitate a class discussion. Using this technique encourages students to think critically about the topics and problems discussed in class and gives them an opportunity to formulate their opinion. During the pairing part of the activity, students are given a low risk environment to practice communicating their ideas and listening to other thoughts generated by their partner. This can be greatly beneficial for students that do not feel comfortable sharing their opinions in front of the whole class.

Resources list

- Textbook - Interactive Lecturing: A Handbook for College Faculty by Elizabeth F. Barkley and Claire Howell Major. Pg 293-296
- https://kpcrossacademy.org/techniques/think-pair-share/

How to Implement in Person and in Zoom

Refer to the section on "Administering Teaching Techniques and Collecting Responses" for some general guidelines on group interactions. Located below are some helpful tip specific to this active learning technique:

- The key to generating quality group discussion is to create a question that has many different viewpoints or solutions. For ideas on how to formulate questions, go to the K. Patricia Cross Academy and download their material on Think-Pair-Share (https://kpcrossacademy.org/techniques/think-pair-share/). below the video is a box that says, "download materials." There is a section in the materials that will provide ideas for creating compelling questions.
- If students that are paired up disagree, then it can be beneficial for each student to clarify their opinions so they can articulate why they disagree.

APPENDIX D. ADMINISTERING TEACHING TECHNIQUES AND COLLECTING RESPONSES

Many active learning techniques and classroom assessment techniques produce some form of student feedback and present the instructor with an opportunity to examine the learning that takes place in the classroom. This section is meant to give a general overview of things to consider when instructors get set to administer teaching techniques for three common formats: multiple-choice/surveys, written response questions, and group interactions. Within this overview are a few suggestions on how to implement techniques in Zoom vs in person, and some tips on how to collect real-time feedback vs archived feedback.

Multiple-Choice/Survey Questions

- Decide on the specific content you want to generate feedback from. This can be a lesson, series of lectures, a discussion, etc.
- focus on the intent of the feedback and what you plan to do with the student responses after they are collected (will the students be graded? Are you trying to spark students recall of information? Ae you trying to find common misunderstanding among the class?)
- Plan the time out of lecture to gather responses, and plan for time to address student responses in the next lesson if you plan on providing feedback to students.
    - If you don't want to use class time to administer a quiz/survey, you might consider creating the quiz/survey in a Google Form and emailing the link with instructions to students so they can complete the quiz/survey before or after the scheduled lecture time. You can consider it an assignment. Instructional time can often be too valuable to take give up.
- Give students expectations on what their responses should look like, how much time they should take to respond, and what you will do with the information that the students provide from the survey or quiz.
- Direct students to either include their name or keep them anonymous, depending on how you will use the information.
    - If you are collecting survey information through Google Forms, go into the settings > general and select/deselect "collect email addresses" depending on if you want the questions graded or anonymous.
- Administer quiz or survey.
    - Zoom
        - Real-time data – Create a quiz/survey using one of the interactive survey programs listed in the "resources for online teaching" section of this document. These programs include Poll Everywhere, Mentimeter, Kahoot, etc. Integrate these real-time surveys into a Zoom lecturing by sharing your screen with the class and giving them the website address and code for them to join the survey. The students will need to toggle between the Zoom window and their survey window to participate in the interactive survey.
        - Archive data – Create a quiz/survey using Google Forms and share the link with students in the Zoom Chat window. This will create an organized collection of responses that can be accessed at any time to be graded or evaluated by the instructor.

    - In Person
        - Real-time data – Use a quiz/survey program listed in the "resources for online teaching" section of this document. I suggest trying Mentimeter since students will be able to respond to survey questions in real-time on their smartphones in class. This will provide the instructor with a real-time compilation of answers from the students.
        - Archive data – If students have access to their smartphones or computers, I suggest creating a quiz/survey in Google Forms and emailing the link to the students. The student responses will be available for the instructor to analyze later.
- Analyze the answers to the quiz or survey and provide feedback to the students if necessary.

Written Response Questions

- Write/tell the students about upcoming open-ended response question so they can keep them in mind during the lecture.
- Provide clear instructions on how students should construct their written responses. Should they write in complete sentences? How long should their responses be?
- Give students expectations on what you will do with the written responses that the students provide.
- During the student response time, make the open-ended questions clear and accessible to the students.
    - Zoom – Create a Google Form with all the open-ended questions listed. At the appropriate time, provide students with a link to the Google Form in the Zoom Chat box.
    - In Person – write questions on the whiteboard or have the questions written on a presentation slide that you can leave up during response time.
- Collect results for analysis
    - Zoom – Tell the students to submit their written answers into the Google Form so instructors can view their submission in the "responses" tab of the Google Form.
    - In person – pass out notecards or sheets of paper for students to respond to the open-ended questions. Collect the paper at the end of class.

Group Interactions

- Pose group discussion questions during the lecture to the entire class and give students enough time to think about the question and formulate a well thought out opinion or answer. It is helpful to write the question on the board so the students can refer to the question.
    - Zoom – instructors can create a Google Document with all the group discussion questions that will be asked during the lecture. Then share a link to the document in Zoom Chat so students can download it and refer to the questions as they are coming up with their responses.
- Before pairing student up into groups, set a time limit for their discussion. Students should be given enough time to share and articulate their thought with each other.
- Collect any group responses for analysis or grading.

    - In person – break people into groups and assign each group a number and a designated notetaker. The designate notetaker is responsible for documenting the group responses and submitting them to the instructor for analysis.
    - Zoom - send students into Breakout Rooms in groups and assign them a group number and group notetaker. Create a Google Document and provide the link in Zoom Chat for the groups to submit their response along with their identifying group number.
- Bring the whole class back together and ask for groups to submit their responses. Then ask for volunteers or select groups to share their best response to the question.
    - Zoom - Use the "broadcast message to all" feature to send out a friendly reminder to wrap up their comments because the Breakout Room session is about to end. End the Breakout Rooms session and check the Google Document to see if all the groups have submitted a response. Then see if any students would like to volunteer to share their opinion with the whole group

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APPENDIX E. RESOURCES FOR ONLINE TEACHING

Poll Everywhere - https://www.polleverywhere.com/

- Use: collect real-time responses to multiple-choice questions and classroom surveys.
- General info: Instructors can set up polls or multiple-choice questions from the Poll Everywhere website. For each poll there is a designated URL that students can access to provide their real-time response from their phone, tablet, or laptop. In addition to the unique URL, they provide a texting option to submit responses if the students have phones without internet access. Instructors must activate poll for students to be able to respond.
- Tips: Can be used in conjunction with Google Slides and Microsoft PowerPoint. You will need to select Pull Everywhere as an Add-on to be able to use the feature.

Mentimeter - https://www.mentimeter.com/

- Use: Collect real-time responses to multiple-choice, short answer questions.
- General info: Instructors can create a quiz with multiple-choice, as well as open ended questions. Most instructors create their questions and administer their question slides all from the Mentimeter website. Students can interact with the quiz straight from a web browser on their smartphone. Students visit the URL https://www.menti.com/ and enter the code associated with the instructor's quiz. For an interactive presentation, the instructor can scroll through each of their question slides and students can submit their response for each question as they come up.
- Tips: Mentimeter can be integrated with PowerPoint, but only with a paid plan. It would be easy to use the free version and administer the quiz from the Mentimeter website and toggle back and forth from your presentation slides.

Kahoot - https://kahoot.com/

- Use: collect real-time responses to multiple-choice questions and classroom surveys.
- General info: Instructors can create a multiple-choice quiz that can be administered to students in real-time. The students can use a smartphone, tablet, or laptop to participate. The instructor starts the quiz on their computer and the students will get an access pin to join the quiz. The students visit the website https://kahoot.it/ and enter the game pin number to start participating. Students do not need to create an account to participate.
- Tips: Instructors can set a time limit for each question. Students get points for answering the questions quicker. This program presents more as a game than a formal survey.

Pear Deck - https://www.peardeck.com/

- Use: collect real-time responses to multiple-choice, true or false, short answer, and a couple more styles of questions.
- General info: Instructors can use Pear Deck as an Add-on in Google Slides (https://www.peardeck.com/googleslides). This allows instructors to create interactive slides within a Google Slides presentation. For the students to submit their interactive answers, they go to joinpd.com and type in the instructors presentation code to join the instructors Pear Deck.
- Tips: For lectures, use the instructor-paced activity so you can click through the slides at your pace and students can interact once they come to a slide with and interactive poll or activity. I

think students might have to add the Pear Deck Add-on in Google Slides to be able to participate.

Scrumblr - http://scrumblr.ca/

- Use: collect student questions, comments, or ideas onto a shared virtual whiteboard. It can also be used as a brainstorming or planning activity.
- General info: This website provides a virtual whiteboard where users can write out ideas or questions onto a notecard and pin them to the whiteboard. This simple format allows for a collaborative space where students can share written responses. To start collaborating, instructors can go to the website, create a new board, and share the link with students.
- Tips: The plus/minus sign on the far-right side of the whiteboard adds/subtracts new columns, and the plus sign on the bottom-left side of the whiteboard adds new notecards.

A few links for more "clicker" response software.

- https://tophat.com/blog/classroom-clickers/
- https://qwizdom.com/education

APPENDIX F. RESOURCES FOR TEACHING TECHNIQUES

Books

Angelo, T. A., and Cross, K. P. (1993). Classroom Assessment Techniques: A Handbook for College Teachers (2nd ed.). Jossey-Bass.

- This book provides detailed explanations for 50 classroom assessment techniques. These assessment techniques range from assessing skills in: problem solving, analysis and critical thinking, course-related learning and study skills, students' self-awareness as learners, and many more. These assessment techniques are a tool for instructors to help understand how their students are learning in their classroom and how effective their teaching practices are at delivering intended learning outcomes.

Barkley, E. F., and Major, C. H. (2018). Interactive Lecturing: A Handbook for College Faculty. Jossey-Bass.

- This book provides instructors with presentation tips to help produce an engaging lecture and active learning techniques that help support student learning during lectures. There are 53 engaging presentation tips that all follow the format of: explanation of the presentation tip, a short example, and a list of additional resources. Additionally, there are 32 active learning techniques that provide: a description of the technique, tips for preparing to use the technique, procedures for implementing the technique, a variety of examples for different classroom settings, variations and advice that instructors can use with the technique, and sources for more information.

Websites

https://kpcrossacademy.org/

- The K. Patricia Cross Academy provides instructional videos and downloadable supplemental material for 47 teaching techniques. The videos for each teaching technique provide a short summary and the downloadable materials provide a detailed guide for instructors to implement the technique, along with additional reading suggestions to learn more about the technique. The primary source material for these videos and documents are textbooks written by Elizabeth F. Barkley and Claire H. Major. Since there is currently a need in todays world for implementing teaching techniques for online learning, they are currently developing guidelines for online adaptation. As of this writing they have 14 online adaptation videos completed. They are working to produce more instructional material in the future.

APPENDIX G. TIPS TO ENGAGE STUDENTS IN ASYNCHRONOUS ENVIRONMENTS

Tips

Break lectures up into a few videos of manageable lengths (5-10 minutes) instead of recording an entire one-hour lecture video. Videos under 10 minutes will hold the attention of students better. Students will have an easier time finding and reviewing specific material from shorter videos. Shorter videos also allow for more engaging activities to take place before or after the short lecture videos. These activities might engage the student in learning the material presented in the short lecture videos.

- Find additional information on lecture videos from Resource 2 and 3 listed below.

Build an effective discussion forum and create other paths of communication where students can interact with their instructor, as well as their peers. It is important for students in online courses to be able to get their questions answered in a timely manner in order to progress through the lectures and coursework. Instructors should provide some combination of discussion forums, scheduled virtual office hours, and sign-ups for additional help. Setting up a structured time for instructors to provide feedback on forums and hold office hours will help students plan their study time better. Some Learning Management Systems, such as Canvas, have features for discussion forums. Consider creating a dedicated message board sections where students and instructors can post questions and answers

- Find additional information on discussion forums from Resource 1 listed below.

Incorporate engaging learning activities that are structured around lectures that will help create deep learning opportunities for students. Student engagement activities can take place before, during, or after online lecture material.

- Examples of student engagement activities
  - Before lecture - “Anticipation Guide”
  - During lecture - “Guided Notes”
  - After lecture - “Muddiest Point”
- Find additional information from Resource 1 and 4 listed below. Resource 1 provides strategies to deepen student learning. Resource 4 provides tips on student engagement activities in an online environment (including asynchronous learning)

Provide students with targeted feedback on their assignments and coursework. Instructor’s time is usually limited in online courses, so it is important to use the finite time to pick opportunities for providing specific feedback. The feedback might be limited to a certain aspect of an assignment due to the instructor’s time constraints, so inform the students that feedback is specifically for a certain aspect of an assignment or project. Then the student will know how to use the feedback to improve their learning and know it doesn’t apply to their whole assignment.

- Find additional information on instructor feedback from Resource 1 listed below.

Communicate the expectations for the online course to the students. These expectations can include the amount of time students should expect to spend on coursework, the availability for help from instructors each week, and the additional resources that students can turn to when they have questions. Some instructors might propose a pace for learning each module/section of the course if the entire course has a specific deadline. This information can help the students keep their learning structured.

- Find additional information on course expectations from Resource 3 listed below.

In addition to original lecture material, consider providing students with links to supplemental material. Using already available internet resources, including documents and videos, can provide additional learning material for students to reinforce their understanding of topics. It also can save time in developing videos yourself.

- Popular educational websites: YouTube, Khan Academy, Coursera

Asynchronous Learning Resources

Resource #1

"Asynchronous Strategies for Inclusive Teaching" from the Sheridan Center for Teaching and Learning at Brown University.

Link: https://www.brown.edu/sheridan/asynchronous-strategies-inclusive-teaching

Description of Resource:

- This resource provides strategies and activities for instructors to consider while creating an asynchronous course.
- Tips on keeping students engaged with asynchronous course material by showing the students the connection between expected learning outcomes and the online course assignments.
- Tips on focusing student attention and creating deeper learning while implementing an asynchronous course.
- Tips on how to provide structured discussion forums for students to deepen their understanding through dialog with their peers and instructors.

Resource #2

"Creating Engaging Asynchronous Lectures with Your Phone or Laptop" from the K. Patricia Cross Academy.

https://kpcrossacademy.org/creating-engaging-asynchronous-lectures/

Description of Resource:

- This resource provides a few quick tips on how instructors can create videos for their asynchronous courses.
- In addition to the article above, the K. Patricia Cross Academy provides many instructional videos for implementing teaching techniques in classrooms (https://kpcrossacademy.org/videos/). For many of the videos, there is a section for adapting the technique for online use. These videos might be useful to reference while creating content for asynchronous courses.
    - Example: the teaching technique in the link below has two videos. The second video, called "Adapting Guided Notes for Online Teaching" describes the Guided Notes teaching technique adapted to online teaching - https://kpcrossacademy.org/techniques/guided-notes/.

Resource #3

"Asynchronous Teaching Tips" from University of Louisiana at Lafayette.

https://distancelearning.louisiana.edu/teach-remotely/asynchronous-teaching-tips

Description of Resource:

- This resource provides seven tips for teaching asynchronous courses: (1) Break up long lectures, (2) Encourage student interaction, (3) Encourage active learning, (4) Communicate expectations, (5) Provide effective feedback, (6) Add instructor presence, and (7) Monitor student activity.

Resource #4

Center for Excellence in Teaching and Learning at Virginia Tech.

Link: https://teaching.vt.edu/

Description of Resource:

- This resource from Virginia Tech provides some resources and tips for teaching online courses and asynchronous courses. This webpage seems to be intended to support Virginia Tech faculty in the transition to online teaching. There are a couple helpful resources that can help provide guidance for asynchronous teaching. One helpful link, located below the "Faculty Tips: building community and engaging students in online courses" section, provides some tips for adapting student engagement activities to asynchronous online courses - https://teaching.vt.edu/content/dam/teaching_vt_edu/Converting%20F2F%20activities%20to%20online_edited.pdf