AC 2011-1528: A NATIONWIDE EFFORT TO IMPROVE TRANSPORTATION ENGINEERING EDUCATION

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A Nationwide Effort to Improve Transportation Engineering Education

Abstract

Over the last year and a half, a group of transportation engineering educators has worked to develop a set of core concepts and learning outcomes for a typical introductory transportation engineering course. To date, the group has developed knowledge tables for the core concepts associated with traffic operations, transportation planning, geometric design, transportation finance, transportation economics, traffic safety, transit, non-motorized transport, and human factors. Further, the group has identified five ways of being (that is, sets of behaviors, actions, and language) that, together with the core concepts, form the foundation for 13 course-level learning outcomes.

The 20 members of the working group, which has become a subcommittee of the Institute of Transportation Engineers (ITE) Education Council, represent 13 different colleges and universities throughout the United States. The development process has consisted of regular conference calls punctuated by a series of face-to-face meetings. Recognizing that stakeholder involvement would be a critical element of success, the group has presented its work to date at the Annual Meetings of the Transportation Research Board in January, 2010 and 2011 and at the 2010 ASEE Annual Conference. In August, 2010 the group held a workshop and conversation circle at the ITE Annual Meeting with the goal of involving practicing engineers in the process. This paper briefly describes the history of this effort. It presents examples of the work to date and discusses the outcomes of the practitioner involvement. The work and feedback have been incorporated into a pilot course that was taught in the Fall of 2010; the paper describes the adaptation and assessment, including lessons learned for a second pilot implementation in Spring, 2011. Finally, the next steps in this effort, including further development and assessment, are explored.

Introduction

Transportation engineering workforce development at the university level is commonly promoted through civil engineering programs. Nearly all of the nation's 224 civil engineering programs have one or two required transportation courses as part of their undergraduate program.[1] For some civil engineering sub-disciplines, such as geotechnical, materials, structures, and hydraulics, a logical sequence of required prerequisite courses leads to the required courses. For other disciplines, such as transportation, the logic and sequence is less clear. A lack of clarity and connection with other sub-disciplines pose significant challenges for faculty, students, and practitioners in transportation engineering. It is likely that these challenges negatively impact the "pipeline" so commonly discussed when considering transportation workforce development.

Transportation is a multidisciplinary field that aims "to provide for the safe, reliable, and efficient movement of people and goods"[2]. However, transportation is facing a perfect storm – an alarming decline of its workforce in the face of increased demand for transportation, not enough workers with skills broader than the retirees to fill the gap, and increased competition from other STEM fields. For example,

- An estimated 40 to 50 percent of the transportation workforce will be eligible to retire in the next 10 years[3,4].
- The growth rate of the labor force has been decreasing with the passage of each decade and is expected to continue to do so in the future[5].

A Georgia Tech report[6] to the U.S. Department of Transportation's Research and Innovative Technology Administration (RITA) states:

> "With population, urbanization, and the need for infrastructure expansion and renewal projected to increase over the next several decades, the demand for transportation professionals could become more acute. If the needs of a growing society that is increasingly dependent on a functioning transportation system are to be met, steps must be taken to motivate students to choose transportation as a career."

The demographic and workforce trends, along with the projected transportation workforce needs of the future, indicate that developing future transportation professionals requires effective strategies to gain the attention of students. These efforts need to proactively address increasing diversity (e.g., women and minority populations), which increases the size of the pool of available professionals, in contrast to a reactive approach that is based on competing for talent from the limited existing pool[7,8].

University-based transportation engineering programs play a critical role in transportation workforce development. Several opportunities have been identified to enhance the effectiveness of university-based efforts to develop an effective transportation engineering workforce to meet the challenges of the future. This paper focuses on a subset of these efforts that target the typical introductory transportation course.

Typical structure for introductory transportation courses

Turochy reported on his 2004 study of the introductory transportation course in the United States[1]. He found that civil engineering students typically enroll in their first course in transportation engineering during the junior year in an undergraduate curriculum; such a course is required for completion of the degree in about 78% of these programs. Subsequently, he gathered and reviewed course syllabi to identify key attributes in the structure and requirements of this class as taught in 30 universities across the United States during the spring 2009 term. The first or introductory course in transportation engineering is a required class in 25 (83%) of the civil engineering programs represented in the review of syllabi. A laboratory component (i.e. associated with one credit hour) was included in 6 (20%) of the courses; in 23 (77%) of the programs, this course is 3 credit hours without an explicit lab component. In 27 (90%) of the courses, the class appears to be focused predominantly on the highway mode of travel. Interestingly, among the 30 course offering reviewed, 9 different textbooks are used, and no particular textbook is used in more than 9 (30%) of the offerings. A review of course topics found that highway geometric design, transportation planning, traffic control devices, highway capacity studies, traffic flow characteristics are addressed in at least 90% of these courses. While consensus appears to exist on the necessity of including these basic and fundamental topics in the class; no other course topic appeared in more than 57% of the syllabi reviewed, indicating a divergence of thought regarding other potential course topics. It is important to note

that course content is shaped by many factors including the relationship of this course to other courses in a particular institution's program, the setting and constituent groups of the institution, as well as the experiences of the course instructor.

History of this effort

A Transportation Engineering Educators Conference was held at Portland State University in June 2009 to identify strategies to address opportunities and needs as described earlier[9]. The conference was designed to bring together university faculty and transportation practitioners to focus on the introductory transportation engineering course and collaborate on ways that it can be improved. The conference's interactive format encouraged the exchange of innovative ideas and best practices, the discussion of current research, and the development of action plans to sustain progress on specific topics after the conference. More than 60 transportation educators and professionals participated in the conference to hear presentations on innovations in transportation engineering education and participate in a series of workshops on defining the learning domain and creating active learning environments for the introductory course in transportation engineering. Three overarching questions provided a unifying theme for the conference:

1. How do we map the learning domain for transportation engineering as it relates to the introductory transportation class?
2. How do we create active learning environments for undergraduate transportation engineering students?
3. How do we develop collaborative tools for sharing transportation engineering curricular materials across instructors and institutions?

The conference produced the following findings[9]:

1. It is critical that the one or two required undergraduate transportation engineering course(s) address a minimum set of core competencies ("learning domain").
2. There should be a common set of knowledge tables that map the learning domains which could be used by instructors across universities as the basis of the required course(s).
3. There is a need for effective strategies that provide *contextual* active learning environments for students in these courses.
4. There is a need to develop collaborative tools for sharing transportation engineering curricular materials across instructors and institutions.

Summary of work to date

Since the Portland conference, a group of approximately 20 transportation engineering educators has collaborated to build on the work initiated at the conference; this group has recently become the Curriculum Subcommittee of the ITE Education Council. To date, the group has produced several sets of materials, working within the framework of backwards course design. A set of course-level learning outcomes and more detailed knowledge tables have been developed (see Findings 1 and 2 above); they are explained in detail by Beyerlein et al.[10] and described briefly here. As detailed by Sanford Bernhardt et al.[11], the group reviewed a variety of efforts to develop bodies of knowledge and learning outcomes, including various approaches and methodologies.

The approaches chosen were a combination of verbs from Bloom's Taxonomy and Wiggins and McTighe's facets of understanding[12] with a knowledge table structure[13].

Table 1 shows the current version of the learning outcomes for the course and Table 2 shows an example knowledge table for Traffic Operations. A knowledge table includes concepts – definitions, diagrams, and models; processes – methodologies; tools; and contexts – situations[14]. Table 3 shows the desired ways of being for a transportation engineer and the associated lifelong skills, which span the cognitive (C), social (S), and affective (A) domains.

Table 1. Course Learning Outcomes

1. Competencies	2. Movement	3. Experience	4. Integrated Performance
1.1 Complete a geometric design for a section of a transportation facility. 1.2 Complete level of service analysis for basic freeway segment. 1.3 Complete signal timing design for fixed time isolated intersection. 1.4 Design and conduct a safety analysis 1.5 Forecast demand for a transportation system 1.6 Explain pavement design referring to standard design and procedures.	2.1 Able to apply the scientific method to transportation problems. 2.2 Able to explain relationship between components of the transportation delivery process and appreciate how course content supports these relationships. 2.3 Increased ability to connect theory with field observations and ability to identify limitations in theory/models	3.1 Connecting driving and pedestrian experiences with transportation terminology and common/classic transportation engineering problems (i.e. safety, congestion, energy, and the environment). 3.2 Heightened awareness of the global transportation system that connects producers and consumers	4.1 Integration of design, operations, and planning concepts to create a traffic impact analysis project. 4.2 Integration of complete streets principles in planning, design, and operations of a transportation system

Table 2. Traffic Operations Knowledge Table

Concepts Blooms: Comprehension Wiggins: Interpretation	Uninterrupted flow: Fundamental traffic flow modeling/relationships • General speed/flow/density model (parameters q, k, and u) • Greenshields realization: linear model relating speed and density • Modified speed-flow model as used in the *Highway Capacity Manual* • Capacity • Levels of service as well as the factors influencing LOS Interrupted flow: Flow with traffic control devices • Queuing models • Urban streets • Traffic signal control (saturation flow rate, signal timing concepts, capacity) • Traffic control process (user, detector, controller, display) • Stop sign control (gap acceptance models) • Performance (delay, levels of service)
Processes Blooms: Application Wiggins: Application	Analyze basic freeway segments to determine LOS • Determine capacity for basic freeway segment (operational analysis) • Determine the number of lanes required to provide a desired LOS (planning/design analysis) Estimate performance for signalized intersection • Determine lane requirements for signalized intersections • Establish cycle length for fixed-time signalized intersection • Determining timing intervals
Tools	• Queuing model for intersections (mathematical and visualization representations) [Bloom: Application; Wiggins: Application] • Narratives in course textbook [Bloom: Comprehension/application, Wiggins: Apply/perspective] • Exhibits from *Highway Capacity Manual*, for example, Exhibit 23-3 *Speed-Flow Curves for Basic Freeway Segments*
Context Bloom: Analysis/synthesis Wiggins: Perspective	• Congested and uncongested highways (relating to personal experiences) • Visualizing traffic flow processes and control in the field at intersections (relating to queuing models) • Planning phase: Use of these analyses to identify candidate highway segments in need of improvement, prioritize proposed improvements • Design phase: Evaluate performance of proposed highway improvements • Operations phase: Evaluate performance of existing highway segments

Table 3. Ways of Being

Way of being	Definition	Life Long Skills
Planner	Anticipating future conditions or needs, the engineer gathers appropriate data, uses appropriate tools, and engages constituents to envision and assess possible courses of action.	cooperating (S) exploring context (C) preparing (A) envisioning possibilities (C)
Decision Maker	When faced with a need to choose among alternatives, the engineer demonstrates initiative, focus, and accountability in recommending a course of action.	identifying key issues (C) choosing among alternatives (C) accepting responsibility (S) checking perceptions (S) being decisive (A)
Designer	When facing a design challenge, the engineer develops robust and well-documented designs based on engineering principles, and tests the design against stakeholder needs.	goal setting (S) simplifying (C) validating (C) documenting (S) seeking assessment (A)
Safety Advocate	Acting from a deep understanding of interactions between the driver, the vehicle, and the roadway, the engineer is keenly aware of safety implications associated with design and policy decisions.	analyzing risks (C) thinking skeptically (A) obeying laws (S) challenging assumptions (C)
Public Servant	Driven by personal and professional values, the engineer proactively engages in the political process and demonstrates integrity and responsibility in engineering practice.	respecting (A) being self-disciplined (A) appreciating diversity (A) identifying stakeholders (C) influencing decisions (S)

Note: C = cognitive domain; S = social domain; and A = affective domain

Need for pilot study

The learning objectives and knowledge tables are the products of an effort to improve the introductory transportation class. Although refinement of the objectives and knowledge tables continues, the group decided it was time to assess their usefulness in designing and/or revising a class. That is, the group wanted to investigate the research question: "What is the impact on students of designing/revising a course based on these learning outcomes and knowledge tables?" One such pilot study was conducted at the University of Wyoming during the Fall, 2010 semester, and a second is being conducted at Lafayette College during the Spring, 2011 semester. The rest of this paper reports the results of the Fall 2010 implementation and briefly outlines plans for the Spring 2011 implementation.

Pilot Study: Course Changes

The Civil Engineering Program at the University of Wyoming requires a junior-level Transportation Engineering course. While many of the students take a follow-up course in transportation, the program only requires them to take one additional senior-level course in four of the five areas (environmental, geotechnical, structures, transportation, and water) offered. Because of this program structure, the Transportation Engineering course may be the only opportunity to introduce students to the broad transportation profession.

The Transportation Engineering Course is offered in both the spring and fall semester every year and is taught by four different instructors on a rotating basis. The course is structured as a traditional lecture course that meets three times per week for 50-minutes over the 15-week semester. There is coordination on course content among the instructors, but ultimately the individual instructor has control over course content. The instructor involved in the pilot study taught the course once per year for seven years before implementing the pilot study changes for the Fall semester of 2010. The course content prior to the pilot study involved covering as many topics in the field of transportation engineering as possible using a popular transportation engineering textbook that is over 1,200 pages in length. The course emphasized exposure to different topics rather than depth in any particular topic.

After involvement in the development of the knowledge tables and learning outcomes discussed previously, the course instructor decided to re-develop the course for the Fall 2010 semester using the knowledge tables and course outcomes to guide course content decisions. This process removed considerable breadth from the course, which provided time to introduce further depth into the most critical topics. Another major change to the course was the addition of a 1 hour and 45 minute lab section to the course. The lab section was scheduled weekly, but the intent was to offer 5-6 labs per semester on key topics and to also use the time for exams.

It is difficult to accurately quantify the change in course content from one semester to another, but using the topics listed in the syllabus as a guide, the total number topics covered in the course was reduced by approximately 25%. As the lecture material for each topic was reworked the focus was again to provide greater depth and to minimize breadth, so the overall content changes were much greater than 25%. Table 4 outlines the course content changes implemented for the pilot study.

Decisions about course content in the pilot study were guided by the knowledge tables and course learning outcomes developed by the ITE Education Council Curriculum Subcommittee. The course objectives for the pilot study were developed directly from the course learning outcomes shown in Table 1 and were listed in the course syllabus as:
When you have completed this course, you should be able to:
  1. *Complete a geometric design for section of a transportation facility.*
  2. *Complete a level of service and capacity analysis for a transportation facility.*
  3. *Complete a signal timing design for a fixed time isolated intersection.*
  4. *Design and conduct a safety analysis for a hazard location.*
  5. *Forecast future travel demand for a transportation system.*
  6. *Perform a flexible pavement thickness design.*

Table 4: Course Content Changes

Topic in original course	Changes made for pilot study
Profession of Transportation Engineering	Added transportation delivery diagram
Transportation Systems and Organizations	Added legislation and funding
Characteristics of the Driver, Pedestrian, Vehicle, and Road (2 days)	No change
"*Divided Highways*" Video to show transportation's societal impacts	Removed
Traffic Engineering Studies	Added lab session
Highway Safety	Expanded by 1 day; expand by another day next time
Principles of Traffic Flow (3 days)	No change
Intersection Design	Removed
Intersection Control	Removed; some material put in new signalized intersection material
Capacity and LOS (2 days)	Changed from rural two lane roads to basic freeway segments
Signalized Intersections (3 days)	Added
Transportation Planning Process (2 days)	Shortened by one day
Forecasting Travel Demand (2 days)	Expanded by 1 day
Evaluating Transportation Alternatives (2 days)	Removed; add one day next time.
Highway Surveys and Location (1.5 days)	No change
Geometric Design of Highways (6 days)	No change
Highway Drainage (2 days)	Removed
Soil Engineering for Highway Design	Remove for next time; put 0.5 day in with flexible pavement design
Bituminous Materials (1 day)	No change
Design of Flexible Pavements (2 days)	Expanded by 1 day
Design of Rigid Pavements (2 days)	Removed

*Topics one day unless otherwise noted

Knowledge tables have been developed for:
- Traffic operations,
- Transportation planning,
- Geometric design,
- Transportation finance,
- Transportation economics,
- Traffic safety, and
- Transit and non-motorized.

The most current versions are collected in a recent Transportation Research Board paper[15]. In developing these knowledge tables, the group recognized that course instructors need to design a course that is consistent with their expertise and the school's geographic region as well as the interests of the students; as a result, the sum of the content outlined in all of the knowledge tables developed to date far exceeds what can be covered in a semester course. The intent of the tables is to provide a structure so that instructors can prioritize course content and to encourage

instructors to go into greater depth in key subjects (See Table 2). That is, it provides a tool to aid in content decisions but does not create a "one size fits all" introductory transportation course. There is still considerable flexibility for instructors to design a course that fits the needs of their students.

Traditionally, introductory transportation courses have focused primarily on the Concepts level of the knowledge tables. In reworking the course for this pilot study, the instructor prioritized the concepts that would be covered and introduced more Process level activities to provide depth. Process level activities were done in the Traffic Operations and Geometric Design areas with much of the hands-on process information being provided in the lab sessions.

The extended lab sessions were used to introduce software and topic integration in ways that would have been difficult in not impossible in the traditional lecture session. The lab sessions for the pilot study course included a field traffic study, use of highway capacity software to analyze different freeway alternatives, use of signalized intersection software to analyze different urban intersection alternatives, review of planning software output to see the change in traffic volumes given different growth scenarios, and a review of a completed geometric design to see the integration of the horizontal and vertical alignments along with project visualizations and a discussion of the design and construction process. The lab sessions were not intended to add additional workload to the course since no additional credit was added the class, so the in-class time gained by the labs was offset in optional review classes during course lecture periods. On average a lab session was held every other week.

Pilot Study: Course Assessment

Assessment of the effectiveness of course changes is often difficult. Mixed methods of assessment can be used to obtain a picture with multiple dimensions (see, for example, [16]). For this pilot study, the multiple methods included course grades, course teaching evaluation scores, and student surveys that build upon the work of Agrawal and Dill[7]. Student performance on comprehensive final exam questions may also be analyzed in the future.

Initial and Final Student Surveys

An initial perception survey that included many of the same questions used by Agrawal and Dill[7] was performed on the first day of class. The survey was administered to the 19 students enrolled in the Transportation Engineering course for the Fall 2010 semester. This initial survey included questions about student interest in the transportation profession as a focus area in their degree program as well as perceptions of what the transportation profession was about. A final survey was also performed in the last week of class to determine if and how student perceptions about the transportation field had changed. The final survey contained additional questions about the usefulness of the lab sessions and the level of breadth and depth in course topics.

The questions asked in the initial survey are shown in Table 5. The first question gauged the student's incoming interest in the transportation profession and used the 4-point scale listed below.
- Very interested in pursuing a career on the transportation profession. (4 Points)
- Am considering transportation as one of my focus areas. (3 Points)

- Have a mild interest in transportation engineering. (2 Points)
- Only interested in meeting graduation requirements. (1 Point)

Table 5. Course Survey Results

Question	Initial Results (n=19) Avg (Std Dev)	Final Results (n=17)* Avg (Std Dev)
1. Which of the following best describes your interest in this course?	2.28 (0.895)	2.85 (0.825)
2. How rigorous do you feel that this course will be compared to the other required junior-level Civil Engineering Courses?	2.00 (0.000)	1.88 (0.332)
3. With respect to your response to the previous question on the rigor of the course, do you view this as a positive or negative aspect of the course? Comment box.	N/A (N/A)	N/A (N/A)
4. Working in transportation engineering involves helping and serving others through personal interaction.	3.88 (0.697)	3.88 (0.697)
5. Working in transportation engineering involves exploring, understanding, and predicting natural or social phenomena.	4.33 (0.686)	4.53 (0.514)
6. Working in transportation engineering involves machines, tools, and materials.	4.56 (0.511)	4.53 (0.624)
7. Working in transportation engineering involves analyzing data to solve problems.	4.56 (0.616)	4.82 (0.393)
8. Working in transportation engineering involves leading and persuading others.	4.12 (0.485)	4.12 (0.928)
9. Working in transportation engineering involves creating and using new knowledge.	4.28 (0.669)	3.94 (0.659)
10. A career in transportation engineering is prestigious.	3.53 (0.624)	3.82 (0.529)
11. It would be easy to get a job in transportation engineering.	3.36 (0.929)	3.42 (0.669)

* Two students were on a field trip the day of the final course survey.

The second question gauged the student's opinion coming into the course on how rigorous they expected the course to be compared to the other junior-level courses in the other civil engineering disciplines. Concern that students perceive the introductory transportation course as not rigorous when compared to the other civil engineering disciplines was one of the motivating factors for the Transportation Engineering Education Conference[9]. The scale used for this question was: more rigorous (3 Points), similar in rigor (2 Points) and less rigorous (1 Points).

Students were also asked to comment on whether the level of rigor of the class was view as a positive or negative (Question 3). Questions 4 through 11 were based on the Agrawal and Dill study and used a 5-point Likert scale from strongly agree to strongly disagree. For numerical analyses a value of 5 was given to a strongly agree response and 1 to a strongly disagree response.

Improvements in the students' perceptions of the transportation field are indicated in final survey values that are higher than the initial survey results. As seen in Table 1 there was an increased level of interest in transportation as a potential profession. There were also improvements in the perceptions involving the profession in; exploring, understanding and predicting natural and social phenomena; analyzing data to solve problems; being prestigious; and ability to find jobs. There were lower scores in the perceptions involving the profession in; working with machines, tools, and materials; and the creation and use of new knowledge. The perception in course rigor also was reduced slightly. No change was observed in the profession being involved in the areas of leading and persuading others and helping and serving others through personal interaction.

From a statistical standpoint, only the first question on level of interest in the transportation profession had a statistically significant difference between the initial and final survey results at a 95% confidence level with a p-value of 0.02. The difference in perception between the initial and final survey results for the questions relating to analyzing data to solve problems and a career in transportation being prestigious were significant at the 90% confidence levels with both having p-values of 0.06.

The final survey asked questions about how students felt about the breadth and depth of the course. Sixteen of the 17 students completing the survey (94%) felt that "just the right amount of topic" was covered in the course. One student indicated that more coverage of pavement materials should be added. With respect to depth 15 students (88%) felt the depth of the topics covered was satisfactory. The two remaining students indicated they wished that additional time could be spent on topics to provide a more complete picture.

Student Grades and Course Evaluations

The grades that students received in the course as compared to course grades under the previous format were also analyzed to provide insight into the effectiveness of the course. As mentioned above the same instructor taught the course for seven times under the "breadth" format and once using the knowledge tables and course learning outcomes. The University of Wyoming uses a straight four-point grade scale with A grades worth 4 points. No plus or minus grades are awarded.

In the previous seven offerings of the introductory transportation courses the average course GPA for the 177 students was 2.97 with a standard deviation of 0.102. Under the breadth structure 43% of the students received B grades and 30% received A grades. Most semesters the instructor lowered the cutoff between A and B grades to raise the number of students receiving A grades. For the pilot study the course GPA was 3.74 with 71% of the students receiving A grades. Other than the changes made to the course described earlier there were no differences in the course with respect to class size, time of day, and cohort group characteristics. This dramatic

increase indicates better comprehension of the material as well as a need to raise expectations on student performance in the course for future semesters. When students were faced with considerable breadth in the course, grades were likely more dependent on memorization of the topics. As the course moved towards greater depth, memorization became less of an issue and student comprehension of the material increased. Grading in future classes will need to challenge the students on material depth more than has been done in the past.

The Civil and Architectural Engineering Department at The University of Wyoming requires teaching evaluations of all of its courses each semester. The teaching evaluations contain 18 questions covering a broad range of aspects of the course and instruction. For the purposes of this assessment just the overall course assessment questions was considered. Students are asked "Overall, how would you rate this course" on a five-point scale from Excellent (1 point) to Poor (5 Points). In the seven previous times the introductory transportation course was taught by this instructor the evaluation scores averaged 2.43, which falls between the very good and good ratings. The standard deviation of these seven scores was 0.335. For the pilot study, the course rating was 1.45, which falls between the excellent and very good ratings.

While the assessment of this pilot course using the knowledge tables and course learning outcomes indicates the course was significantly improved there is always room for additional improvement. The instructor intends to remove one or two more topics from the course in order to expand and provide greater depth into the safety area of the transportation field.

The purpose of the pilot study was to see whether implementing a new approach to course design in the introductory transportation course would have an effect on both the student perceptions of the material and on student learning. Improving student perceptions of the material is necessary to attract students to the profession, which addresses the critical workforce challenges discussed earlier in this paper. Improving student learning is the goal of any course. The three assessment methods (student perception survey, student grades, and course evaluations) all point to improvement in the course. Additional pilot studies at other colleges and universities will demonstrate the extent to which these conclusions are transferrable.

Next steps

Building on the lessons learned from the initial pilot study, a second pilot study is being conducted during the Spring 2011 semester at Lafayette College. Lafayette College is a much smaller institution; however, the class size is much larger (34 students). Other differences between the courses at the University of Wyoming and Lafayette College include a longstanding 3-hour lab period at Lafayette College (with much smaller section sizes) that supplements the traditional class periods and the student composition – approximately 2/3 of the students in the course at Lafayette College are sophomores. Course content is similar, but not identical, and the assessment methods are the same.

Work is continuing to improve the introductory transportation engineering course. The group is currently pursuing funding to develop activities associated with knowledge tables and course learning outcomes to aid instructors in implementing course changes. Current information on this effort can be found on the ITE website under the Education Council page.

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