

# Developing Course Modules on Social Equity for Transportation Courses in Engineering and Construction

*CTIPS-019 – Full Project Description*

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## Description

Equity issues have gained attention among practitioners in the transportation field, but the importance of social and equity considerations has not necessarily been incorporated into degrees in civil engineering, construction management, and related fields. This project aims to develop several modules on social equity issues in transportation that can be incorporated into transportation courses and general civil engineering and construction courses. The modules will be structured in a way that allows course instructors to tailor the content to account for the diverse levels of knowledge and needs of students (i.e., undergraduate vs. graduate students and transportation specific courses vs. general civil engineering and construction courses). The course modules for each topic will include introductory content including terminology and theory as well as the historic origins of modern issues. Course activities and assignments within each module will require students to use social equity knowledge in a technical setting.

Once finalized, these modules will be made available to the greater academic community by posting them on online repository(s), allowing faculty teaching transportation, civil engineering, and construction courses across the nation to incorporate them into their respective courses as appropriate. This will ensure a wide outreach and result in a broader impact of the proposed research.

Addressing the social equity challenges of a community is an inherently multi-disciplinary activity as it draws on social science, historical context, and the availability of technical solutions. The course modules we develop will provide students with basic information from these important fields of study outside of engineering with the goal of helping engineering and construction students to understand the need to engage and collaborate with different types of experts to advance social equity. Transportation equity is also a challenge that lends itself to multi-modal thinking. Equity means providing people with transportation resources that recognize their particular life circumstances and needs. In fact, in recent interviews with personnel working in various levels of transportation agencies, several interviewees described choice for individuals as a key aspect of transportation equity. An integrated multi-modal transportation strategy helps people with different abilities and resources to access needed services and participate fully in civic life.

## Project Objectives

This project has four objectives:

1. Assess the educational needs of civil engineering and construction students related to equity in transportation through interviews and surveys with transportation professionals.
2. Develop learning modules to prepare civil engineering and construction students at a variety of levels to address transportation equity issues in their professional work.
3. Implement and evaluate the learning modules to refine the activities and content.
4. Share the learning modules with civil engineering and construction faculty through established venues such as curriculum repositories.

## Relevance to Strategic Goals

This project primarily addresses the USDOT strategic goal of equity. This project is expected to advance transportation equity by helping to prepare the future transportation workforce to address equity in design and decision-making. This project also addresses the climate and sustainability goal, as equity is a key component of the social pillar of sustainability.

## Outputs through Technology Transfer

This project will produce learning modules and curriculum activities for use in civil engineering and construction courses. The learning modules will teach students about equity issues in transportation and will provide students with skills in accessing and interpreting data to create more equitable transportation decisions. The learning modules will be shared with faculty and instructors nationwide through conference presentations and by posting modules or assignments in online repositories.

## Expected Outcomes and Impacts

Among the three pillars of sustainability, social equity has received comparatively little attention within the transportation courses offered in both undergraduate and graduate curricula in engineering and construction related programs of study. This project aims to incorporate social equity and justice related education topics, such as the social impacts of the transportation-related decisions on communities and infrastructure end-users, into transportation courses and to bring transportation related topics into general civil engineering and construction courses. The proposed course modules will help undergraduate and graduate engineering and construction students enrolled in these courses to understand and incorporate social equity into their professional roles as key decision-makers for the design and construction of the transportation infrastructure. This will help build stronger societies by reducing negative social impacts of the transportation infrastructure, particularly in communities that are currently overburdened and have a history of underinvestment.

## Work Plan

This project will be conducted over three phases: (A) needs assessment, (B) content development and pilot delivery of the modules, and (C) module evaluation/improvement and online repository development. This project will include the specific tasks and activities discussed below.

1. **Conduct the literature review:** This activity will include the review of existing literature primarily with respect to social equity in transportation, incorporation of social equity into engineering and construction education, and decision-making in transportation.
2. **Develop the surveys and interviews:** A survey to understand how undergraduate and graduate engineering and construction students perceive social equity will be developed to assess their needs and identify their concerns and suggestions. Additionally, the plan includes interviewing professors and practitioners in the transportation field to tailor course modules that will address the needs of the future professional roles of the students and their expected tasks. For both activities, survey and interview protocols will be developed, and IRB approval will be obtained.
3. **Conduct the surveys and interviews:** After the IRB approval, both the surveys (targeted at engineering and construction students at Colorado State University) and interviews (with professors and practitioners in the transportation field) will be conducted concurrently. We plan to conduct rigorous analysis of the data collected using qualitative content analysis on open survey responses and reflexive thematic analysis on the interview data. If appropriate we will prepare a journal article with our findings, and the findings will be used to inform course module development.
4. **Develop the course modules:** The course modules will be developed based on the information gathered from Tasks 1-3. We plan to select topics and develop modules with content that can be customized to a range of different student levels and course contexts. For example, course assignments might ask students to work with data from the American Community Survey from the U.S. Census Bureau or various environmental justice screening tools to help them understand the context of transportation services and construction projects. An instructor of an undergraduate level course might rely heavily on the introductory content, while an instructor at the graduate level could push students to see how the contextual information they collected could be incorporated into project decision making. We also plan to select assignment topics that require students to engage with data. In a past effort one of the researchers used a transportation case study (about a large-scale highway reconstruction project in the region) relying heavily on historical context and local news articles about community response. While this assignment was generally well received, some student responses to the activity indicated skepticism that the activity was “engineering” (Casper et.al 2024). In a follow-up effort incorporating quantitative data in a hydrology class seemed to eliminate this concern. The modules will emphasize the roles of different types of data, both quantitative and qualitative, and different types of professional expertise needed for equitable transportation engineering. The modules will also include recommendations about how the content could be adapted for incorporation into different types of courses.
5. **Test the course modules:** The developed modules will then be assessed by delivering them in a few pilot courses, both at the undergraduate and graduate level, at Colorado State University and possibly other CTIPS-member schools.
6. **Evaluate and improve the course modules and develop the online repository:** The course modules will be improved by revising their content and approaches based on the feedback received from Task 5. The finalized modules will be added to an online repository, making those accessible to faculty teaching transportation courses across the nation and allowing faculty to incorporate the modules into their respective courses as appropriate. We plan to investigate existing repositories of engineering and construction course materials so that our content can be readily identified by engineering educators. An example repository might include Engineering Unleashed (https://engineeringunleashed.com/). We will also post materials on Mountain Scholar, the open access, online repository hosted by Colorado State University.
7. **Prepare the final report**: A final report documenting this research effort will be prepared and submitted to the Center for Transformative Infrastructure Preservation and Sustainability (CTIPS).

The table below depicts the schedule of the abovementioned phases and activities across the two years.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Tasks / Activities** | **Quarters** | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| A | 1. Conduct the literature review | X | X |  |  |  |  |  |  |
| 2. Develop the surveys and interviews |  | X |  |  |  |  |  |  |
| 3. Conduct the surveys and interviews |  |  | X | X |  |  |  |  |
| B | 4. Develop the course modules |  |  |  |  | X |  |  |  |
| 5. Test the course modules (pilot delivery) |  |  |  |  |  | X |  |  |
| C | 6. Evaluate and improve the course modules and develop the online repository |  |  |  |  |  |  | X |  |
| 7. Prepare the final report |  |  |  |  |  |  |  | X |

## Project Cost

Total Project Costs: $ 110,000

CTIPS Funds Requested: $ 55,000

Matching Funds: $ 55,000

Source of Matching Funds: Colorado State University

## References

Casper, A. A., Atadero, R. A., Abdallah, A. R., & Siller, T. (2024). Bringing Social Justice Context into Civil Engineering Courses for First-Year and Third-Year Students. *Journal of Civil Engineering Education*, *150*(2), 04023013.