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MTI **MINETA TRANSPORTATION INSTITUTE**

Promoting Interest in Transportation Careers Among Young Women

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CSUTC **California State University Transportation Consortium**

SJSU **SAN JOSÉ STATE UNIVERSITY**

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16. Abstract

Transportation remains the largest source of U.S.-based carbon emissions, and reducing emissions from this source continues to challenge experts. Addressing challenging problems requires diverse modes of thinking—and at present the transportation workforce is not diverse in terms of gender, with women occupying only about 14% of the transportation workforce. This research developed and tested a school-based intervention that uses pro-environmental framing and exposure to women transportation role models to help attract more women to transportation careers. To investigate the efficacy of the intervention, the research team studied control and treatment groups of university students using pre- and post-surveys to measure changes in student understanding and interest in transportation fields and careers. Students in both groups were enrolled in a climate change course, and students in the treatment group completed an additional transportation learning module designed to stimulate interest in transportation careers. The results showed that by the end of the semester, student awareness that the transportation industry can provide green and sustainable careers increased by 39.7% in the treatment group compared to no change in the control group. In addition, student openness to working in a transportation-related career increased by 17.5% for females in the treatment group compared to no change in the male treatment group and no change in the control group. Given the success of this intervention, similar educational modules at various educational levels could increase the number of women working in transportation. Should such approaches be successful, society will be better prepared to respond to environmental challenges like climate change.

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Executive Summary

In the United States, a pressing need exists for a workforce with diverse skills, experiences, and backgrounds to adequately respond to society's biggest challenge—climate change. The persistent lack of representation of women in STEM fields continues, and although women have increased their representations in some fields only about 14% of the transportation workforce are women (Godfrey and Bertini, 2019). This is especially problematic given the critical role that transportation innovations will play in the coming decades as society seeks to decarbonize our economy and stabilize the climate. The research presented here leverages the findings and recommendations of prior work on how to attract and retain women in the transportation industry (e.g., Agrawal and Dill, 2008; Drury et al., 2011) by developing and testing a college-level educational intervention that uses pro-environmental framing and exposure to female transportation role models to help attract females towards careers in transportation.

The research team began by designing a one-class transportation learning module. In this module, students learned about the environmental benefits of transportation innovations and were introduced (via video) to prominent female transportation professionals working in climate-solutions-related fields. The learning module was embedded within a general education climate change course offered at a university. In the experimental design, students (n=90) taking the climate change course were placed into either a control group (no learning module) or a treatment group (with learning module) where both groups of students completed a survey at the beginning and end of the semester (hereafter pre- and post-survey) designed to measure student understanding and interest in transportation fields and careers. Analysis of the survey data and student written responses from the learning module were analyzed to study the effectiveness of this intervention.

After completing the climate change course that included the one-class transportation module, we found that female students were more open to working in a transportation career by the end of the semester (17.5% increase) compared to the control group, which showed no statistically significant change. In addition, all students who were exposed to the transportation module better understood (39.7% increase) that the transportation industry can be a green and sustainable career. The research team recommends that similar one-class modules that use environmental framing and exposure to role models can be employed within different educational settings (middle school, high school, and college) to more broadly expose young women to transportation career pathways.

1. Introduction

Climate change and its associated environmental, social, and economic impacts are widely recognized as the dominant challenge confronting humankind this century. Scientific reports (e.g., IPCC, 2021; Ripple et al., 2020) continue to document the significant changes to our present climate system and project future changes should emissions of greenhouse gases continue at present rates. In California, although progress is being made to reduce emissions from electricity generation, by far the largest producer of carbon emissions (39%) is the transportation sector (California Air Resources Board, 2021). For California to reach its target emission reduction goal, significant changes in transportation infrastructure and personal behavior will be needed. To achieve such goals, California will need diverse skills, experiences, and backgrounds within its transportation workforce. This research builds on the documented lack of women working in the transportation industry (Godfrey and Bertini, 2019) and focuses on developing and testing a college-level educational intervention that uses pro-environmental framing and exposure to female transportation role models to help attract females towards eventual careers in transportation.

The goal of this project is to create an academic intervention that attracts young women towards transportation careers. Building on existing research regarding women in the transportation industry, the primary objective of this study is:

To evaluate the effectiveness of an academic intervention that uses pro-environmental framing of transportation, in conjunction with positive role models in the transportation industry, as a method of attracting female students towards transportation careers.

In Section II, a literature review will describe earlier work in this area and show how this study has explored new aspects of career education. Section III will then describe the methods of this work, including the development of the curriculum, data collection processes, and data analysis. In Section IV, the analysis and findings of this research will be provided, followed by the conclusions and recommendations in Section V.

2. Literature Review

There is considerable literature describing the lack of representation of women in STEM fields (García-Holgado et al., 2019; Hand et al., 2017; Kahn and Ginther, 2017; Milgram, 2011; Toossi, 2002). Although the number of women participating in the workforce has grown since the middle of the 20th century the distribution among occupations has not been homogenous, with women accounting for only around 14% of the transportation workforce (Godfrey and Bertini, 2019).

Findings and recommendations from the literature describe methods to attract, promote, and retain women in the transportation industry (Godfrey and Bertini, 2019; Hegewisch et al., 2014; Ivey et al., 2012; Stevens et al., 2019). Among methods shown to work, two main themes emerge. The first theme is the need to provide young women with opportunities to experience the transportation field at a personal level (Hanson and Murakami, 2010), either through direct connection with professionals or through hands-on transportation projects and field trips. The notion of early exposure to positive role models has been credited with success in other fields (DeJarnette, 2012), and many professionals think similar actions would benefit the transportation industry.

The second theme centers around how transportation is perceived, and the understanding that women are generally attracted to professions that include more communal goals (U.S. Agency for International Development, 2017; Weisgram and Diekman, 2015). Various studies have documented that when connections between the social and human benefits of STEM work are demonstrated, women's interest in these STEM fields increases (Boucher et al., 2017; Diekman et al., 2011; Klotz et al., 2014).

These findings and recommendations informed the research team in the development of an educational experience that emphasizes the connections between climate change, the social and human benefits of climate change solutions, and the important role that transportation professionals are having in creating climate solutions. Prior research on the role that education can have on influencing students' pro-environmental attitudes and behaviors, even many years after the educational experience, have been documented (e.g., Cordero et al., 2020; Kwauk and Casey, 2021). The focus of the research reported here is to evaluate whether an educational intervention, designed around exposure to positive role models and pro-environmental thinking, can influence young women's attitudes towards the transportation industry and transportation careers.

3. Methodology

The research team designed a one-class transportation learning module that could be embedded within an existing university course focused on the connections between climate change, transportation-related climate solutions, and transportation careers. The goals of the learning module were (a) to help female students realize the potential role that the transportation industry can have in mitigating climate change and (b) to help female students realize how transportation careers could be a good career path for individuals who want to work in an area that improves the lives of people.

Course and Student Recruitment

The transportation learning module was embedded in *METR 112: Global Climate Change*, a San José State University (SJSU) upper-division course fulfilling the general education requirements in the area of Earth and the Environment. The course is relatively popular with 12 sections offered and over 400 students enrolled per semester. The focus of the course is on the science behind climate change, and at least a third of the instructional time is focused on climate change mitigation and adaptation. Since the designed learning module describes connections between climate change and transportation, the topic fits well within the existing course syllabus. METR 112 is a three-unit class (30 class meetings per semester, and each meeting is 1 hour and 15 minutes), so the one-class learning module only represents a small percentage of the total instructional time. The research team was interested in understanding whether small modifications to an existing curriculum could have a discernable impact on student attitudes and career interests.

Recruitment of student participants was conducted at the beginning of the course through a combination of personal visits to the class by a member of the research team and/or electronic notifications through the course learning management system. Student participants who consented to participate in the study were then asked to complete the pre-survey (See Appendix A) during the first two weeks of the semester. There were 145 students who consented to participate in the study, which was about 34% of the total enrolled students. Of those students, 90 students completed both the pre- and post-surveys with the number of students in each group and their genders provided in Table 1. Although the research team had expected a higher participation rate (i.e., 50%) and completion rate (80%) based on previous studies with similar groups of students, the presence of the Covid-19 pandemic during the research period very likely made recruitment and data collection more challenging. Even so, the number of participants is sufficient to make conclusions at the 90% confidence level with an 8% margin of error (Qualtrics, 2021). Although higher confidence levels and lower margins of error would be preferable, the sample size was adequate to make data-based claims regarding the primary research objectives.

Table 1. Student Participants by Group and Gender

Group	Combined	Male	Female
Control	48	14	34
Treatment	42	10	32
Total	90	24	66

The distribution of students by group and gender participating in the study

Transportation Learning Module

A one-class learning module on transportation was designed to encourage students, and in particular female students, to consider that working in the transportation industry could be a green and sustainable career opportunity. The framework for the learning module had two components which were designed with female students in mind. The first component was a pro-environmental framing of the transportation industry. This was provided through a video lecture that students watched documenting the potential climate benefits that would result from innovations in transportation. Compared with male students, female students have been shown to have a stronger affinity towards careers that focus on other people rather than on themselves (Boucher et al., 2017; Diekman et al., 2017; McGinn and Oh, 2017). By framing transportation-related solutions to climate change, the authors promote the human benefit to working in certain areas of the transportation industry. The second component, using recorded video interviews, was to introduce students to transportation professionals who are working in areas that directly provide environmental and climate benefits. It has been shown that exposure to positive role models has a significant impact on student attitudes towards that field (DeJarnette, 2012; King, 2017). Of the interviews included in the learning module, 80% were with females, and all were with transportation professionals working in a climate-solutions field. A visual overview of research design including the learning module is provided in Figure 1.

Figure 1. Outline of the Experimental Design
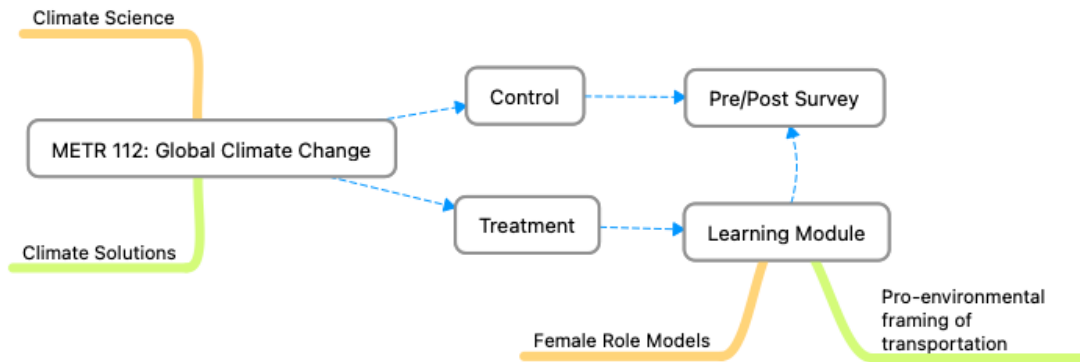
The diagram outlines how the experience for the treatment group differed from the control group.

The learning module was provided via the course learning management system to the participating instructors. There were three components to the learning module as detailed in Figure 2 and described below.

Figure 2. Components of the Transportation Learning Module
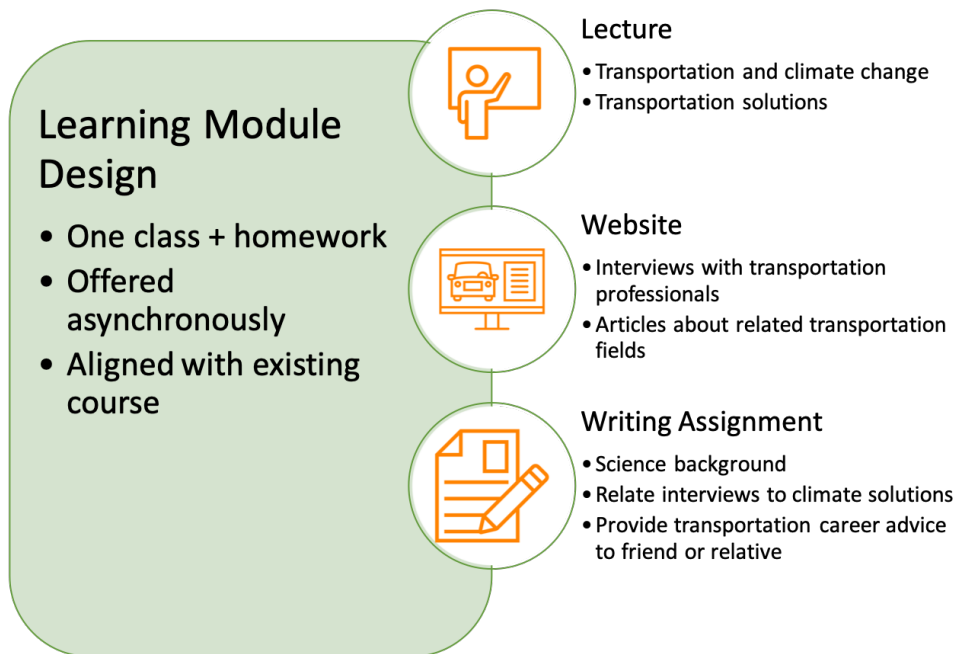
An outline of the materials that were provided to the treatment group of participating students.

Lecture

First, students were first asked to watch a 32-minute lecture developed for this learning module that provided detailed connections between transportation and climate change (Cordero, 2021). The lecture outlined how transportation-related emissions are important contributions to climate change a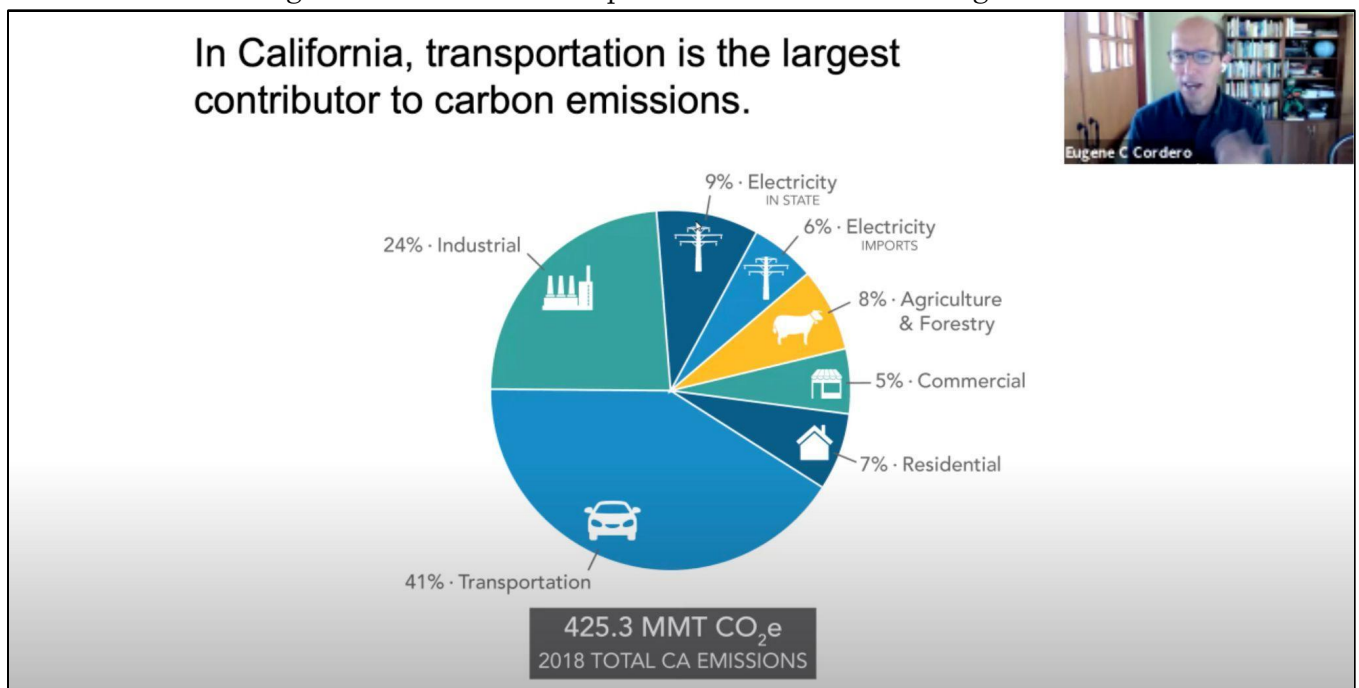nd how innovations to the transportation industry are needed to adequately mitigate climate change. Using the course learning management system, a simple quiz was embedded in the video to encourage students to watch the entire video. Data from the quiz was not used in this study.

Figure 3. Lecture on Transportation and Climate Change

A screenshot from the lecture provided to the treatment group of students (Cordero, 2021).

Website

Second, students were asked to visit the Careers for Change website (www.careersforchange.net) and watch videos of three of the featured transportation professionals and the articles accompanying each professional (see Figure 4). The website was designed by the research team and includes 5–8 minute interviews with transportation professionals, as described in Table 2. Together with each interview, articles are included that relate to the primary field of the transportation professional. The research team chose to reach out to professionals from different sectors of the transportation industry to broadly illustrate the varied careers within transportation and the diverse career paths that align with green and sustainable careers.

Figure 4. Careers for Change Website
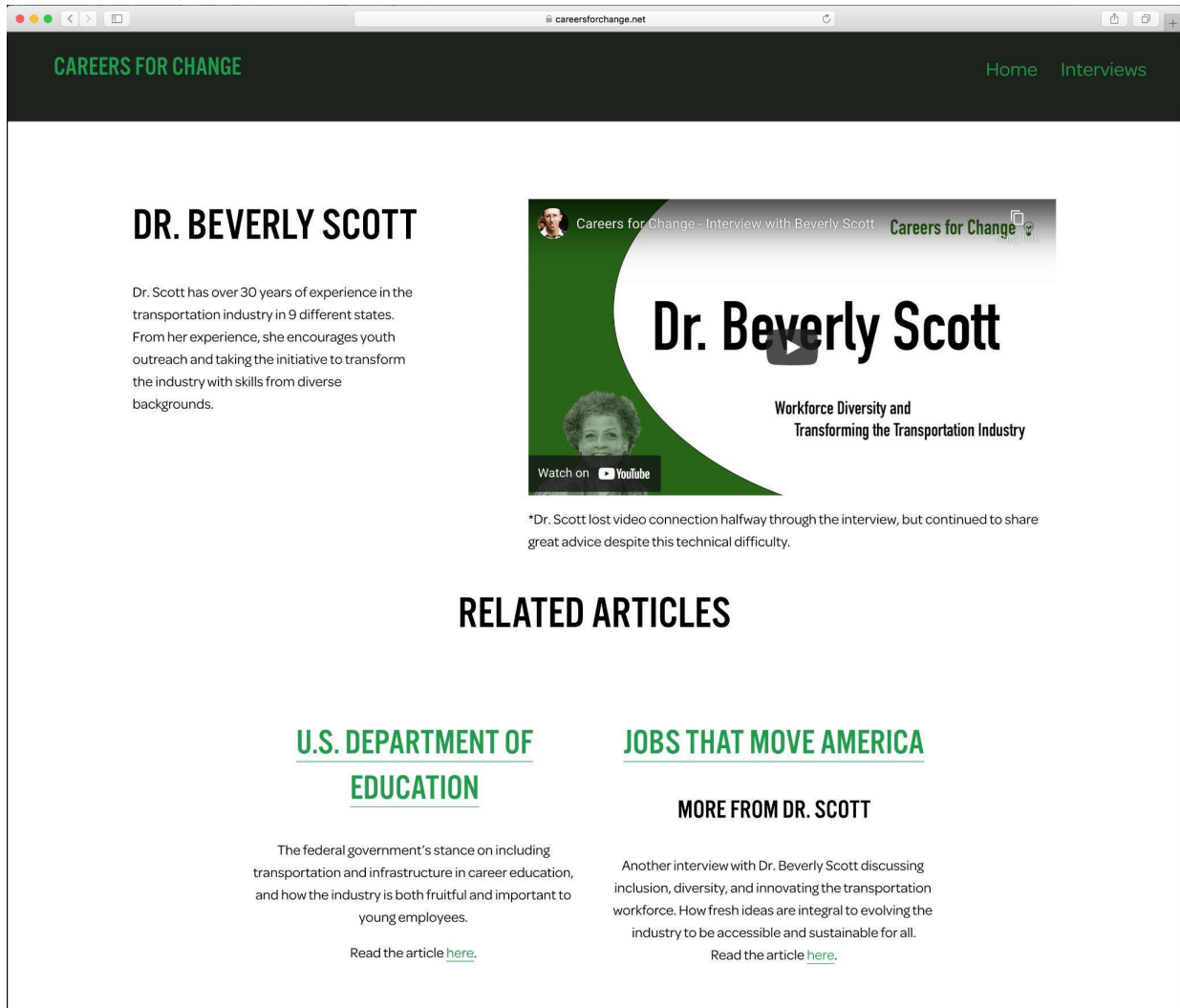
Screenshot from the website (www.careersforchange.net) provided to the treatment group of students

Writing Assignment

Third, students were given a writing assignment (see Appendix B) where they were asked to answer three questions that encouraged them to reflect on connections between climate change and transportation careers. In particular, the third question asked:

Today you watched a series of interviews about professionals in the transportation industry. Imagine a sibling, relative, or friend said they would like to pursue a career that does good for the environment. Based upon what you've learned, what career would you recommend and why?

The intention of this question is to get students to advocate for how transportation may be a good career opportunity. Rather than asking students to consider transportation as a career option for themselves, positioning them as advocates for someone they care about may encourage a more

lasting impression. A rubric was created to evaluate student responses to the assignment, and details of the analysis of student responses are provided in the Analysis and Results section.

Table 2. List of Interviewed Transportation Professionals

Interviewee	Employer	Transportation Specialty
Michelle Boehm	California High Speed Rail	Regional director of California's high-speed rail for the last seven years
John Brazil	Department of Transportation, City of San José	Managing the Active Transportation Program to support safe and efficient options for bicycles and pedestrians
Rachel Donovan	Structures and Maintenance, CalTrans	Engineering professional focused on inspections of Bay Area toll bridges
Dr. Hilary Nixon	Mineta Transportation Institute, San José State University	Professor and researcher specializing in transportation and environmental planning
Dr. Beverly Scott	Beverly Scott and Associates	Nationally recognized transportation professional and public transit advocate

The names and affiliations of the transportation professionals who were interviewed for the Careers for Change website.

Survey and Evaluation

The effectiveness of this curriculum was evaluated by two methods. The primary method was analyzing data from the pre- and post-survey responses to evaluate how student attitudes shifted over the semester. A copy of the complete survey can be found in Appendix A with a list of the primary research questions provided in Table 3. The second method was an analysis of the open-ended student responses to the writing assignment.

The analysis of the survey data was conducted using statistical methods. First, only students who completed both the pre- and post-surveys were included in the study (n=90). Then student responses were assigned numerical values ranging from 1 for "strongly disagree" to 5 for "strongly agree." This method assumes an equal interval between each of the student responses and allows for a paired t-test to determine the confidence level observed between the difference in the means of the pre- and post-surveys. In the following analysis, we assume that any confidence level greater than 90% is statistically significant. The subsequent results and charts focus on the changes between pre- and post-surveys. They indicate the percent of student responses for both "strongly agree" and "agree," and they indicate whether the reported changes are statistically significant.

4. Analysis and Results

Survey Analysis

The 16-item survey was completed by students at both the beginning and the end of the semester for both the control and treatment groups (see Appendix A). The first seven questions focused on student demographic information and the last nine questions were Likert-scale statements about the environment and transportation, with the exception of Q2 (see below), in which the answer options ranged from 'a great deal' to 'none at all'. We analyzed the results from the survey questions (see Table 3) to determine (a) how the climate change course affected student attitudes about climate solutions and transportation, (b) how the transportation learning module affected student attitudes about climate solutions and transportation, and (c) how the transportation learning module affected female attitudes towards transportation careers.

Table 3. Survey Questions

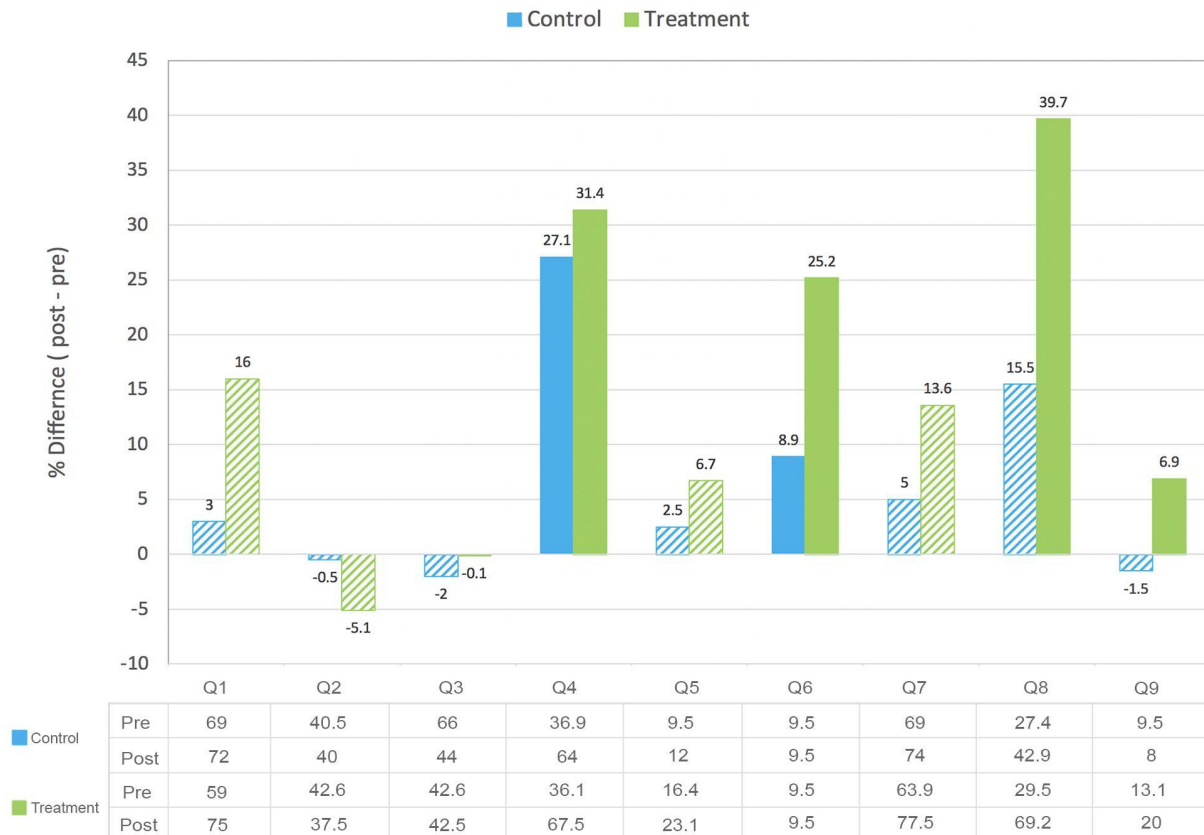| Q1	I care about environmental issues.
Q2	How much do you think global warming will harm you personally?
Q3	The actions of individuals will not make a difference in climate change.
Q4	I am aware of actions I can take to reduce climate change.
Q5	I am interested in a career that works to reduce climate change.
Q6	I have some understanding about green and sustainable careers.
Q7	Improvements to transportation can make significant impacts on climate change.
Q8	Working in the transportation industry can be a green and sustainable career choice.
Q9	I would be open to working in a transportation-related career.

List of questions that were asked in the pre- and post-survey for both treatment and control groups, where students responded using a 5-element Likert scale (i.e., strongly agree, agree, neutral, disagree, or strongly disagree) except for Q2 where students responded using a 5-element scale ranging from 'a great deal' to 'none at all'.

(a) The climate change course

To examine the impact of a 15-week course on climate change, student results from the control group were used to evaluate student attitudes about climate change and transportation (see the control group data in Figure 5). Statistically significant results of the pre- and post-survey indicate that students became more aware of climate solutions as a result of the course. For example, student responses to 'I am aware of actions I can take to reduce climate change (Q4)' increased in the

strongly agree category by 27.1% by the end of the semester, and responses to 'I have some understanding about green and sustainable careers (Q6)' also increased in the *strongly agree* category by 8.9% by the end of the semester. These results suggest that general education courses, such as this one focused on climate change, do increase student understanding about climate solutions. In terms of connection to the transportation industry and other questions about climate, there were no statistically significant changes in any of the other survey questions within the control group.

Figure 5. Results for all Students—Control vs. Treatment

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Control	Pre	69	40.5	66	36.9	9.5	9.5	69	27.4	9.5
	Post	72	40	44	64	12	9.5	74	42.9	8
Treatment	Pre	59	42.6	42.6	36.1	16.4	9.5	63.9	29.5	13.1
	Post	75	37.5	42.5	67.5	23.1	9.5	77.5	69.2	20

Difference between student responses from the pre- and post-survey questions for the *strongly agree* category (except for Q3 where the *strongly disagree* category is studied) for students who were in the control group or treatment group. The solid bars represent differences that are statistically significant at the 90% confidence level, while the striped bars are not statistically significant. The table embedded below the chart provides the percentage of students who answered *strongly agree* for each pre- or post-survey response.

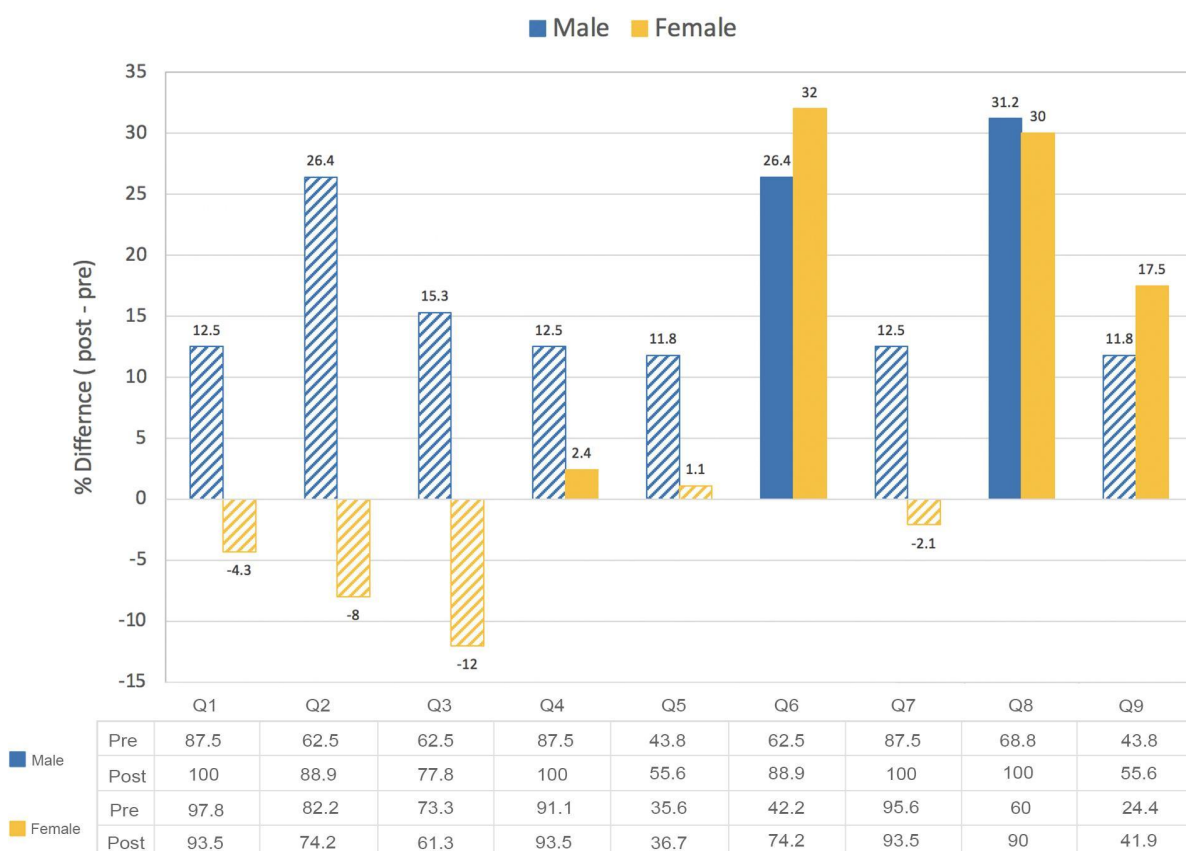**(b) The transportation learning module**

The survey data were then used to evaluate the effectiveness of the learning module on students in the treatment group. For the questions related to climate and the environment (Questions 1, 2, 3, 5, 7), no statistically significant changes were seen in the pre- and post-survey responses. These results are similar to the control group. However, for the remaining questions about climate solutions and transportation, statistically significant changes were seen in the treatment group by

the end of the course. Similar to the control group, students in the treatment group were more aware of actions they could take to reduce climate change by the end of the semester (Q4 showed a 31.4% increase in the *strongly agree* category). For the remaining questions related to careers and transportation, students in the treatment group had significantly larger changes in responses compared to the control group. For the remaining questions related to careers and transportation, students in the treatment group had significantly larger changes in their responses compared to the control group. Indeed, for questions 6, 8, and 9 students who participated in the transportation module significantly increased in the *strongly agree* response at the end of the semester (Figure 5). This analysis strongly suggests that the transportation learning module did impact how students thought about green and sustainable careers, and especially in connection to transportation careers.

(c) Females and the transportation learning module

By partitioning the survey data by gender, female responses were evaluated. In the first half of the survey (Qs 1–4), both female and male student responses from the treatment group in the pre- and post-survey questions were generally similar. However, in the second section of the survey, that focused more on careers and transportation, some gender differences were identified (Figure 6). In questions 6 and 9, females increased their positive response (*agree* + *strongly agree*) more than males, while in the other questions, the responses were similar. However, because of the relatively small sample size of the treatment group when separated by gender, there was no statistically significant difference in how males and females responded to each question at the end of the course when the data was compared using a student's t-test. So, although the intervention increased student interest in transportation careers, within this collection of student responses, we could not detect significant differences in how females responded compared to males.

Figure 6. Results for Female vs Male Students

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Male	Pre	87.5	62.5	62.5	87.5	43.8	62.5	87.5	68.8	43.8
	Post	100	88.9	77.8	100	55.6	88.9	100	100	55.6
Female	Pre	97.8	82.2	73.3	91.1	35.6	42.2	95.6	60	24.4
	Post	93.5	74.2	61.3	93.5	36.7	74.2	93.5	90	41.9

Differences between female and male student responses from the pre- and post-survey questions for the *agree + strongly agree* categories (except for Q3 where the *disagree + strongly disagree* categories are studied) for students who were in the treatment group. The solid bars represent differences that are statistically significant at the 90% confidence level while the striped bars are not statistically significant. The table embedded below the chart provides the percentage of students who answered *agree or strongly agree* for each pre- or post-survey response.

Written Responses Analysis

Student responses to the writing assignment (see Appendix B) were collected and analyzed using a rubric. The first question on the assignment asked students to describe the connections between transportation and climate change. Answers that included the impacts of transportation on climate change and how solutions to climate change exist through innovations received the highest score. In general, students scored well on this item (3.78/4.0) with most students understanding the basic relationship. In the second question, students were asked to describe how one of the interviewed professionals' career paths is helping to reduce carbon emissions. Again, student scores were relatively high (3.75/4.0) with most students able to successfully connect professional careers with carbon reductions. For example, many students cited examples such as high-speed rail, urban planning, and building biking infrastructure within urban areas as work fields that could reduce emissions. In the final questions, students were asked to provide transportation-related career

advice to a hypothetical sibling, relative, or friend who had expressed interest in a career that improves the environment. Student scores were again high (3.73/4.0) as students frequently used the careers of the interviewed professionals as concrete examples for their advice.

A couple of themes were identified in the student responses. First, students frequently commented about the diverse ways individuals can enter the transportation workforce. Students mentioned that many transportation professionals did not initially intend to work in that field, but they were exposed to this area through volunteer or other professional opportunities. Relatedly, students commented that there is not typically a transportation major in universities, but that graduates from many different areas can enter into the transportation workforce. It appears that many students felt they could see themselves (or in this case, their relative or friend) having career options in the transportation industry even if they did not have a transportation engineering degree. A second theme that emerged in a few of the responses was about the prominence of women in career fields that are traditionally male-oriented. This was most often connected to the interview with Rachel Donovan, who in her interview discussed what it was like being the only female rope-certified bridge engineer in California. A number of responses mentioned Rachel Donovan and how more women should consider this field because Rachel's experience showed that it was a rewarding career. A final theme mentioned in a majority of student responses emphasized that transportation careers were a good way to do something positive for the environment. This idea, which was one of the key themes in the transportation module, did appear in many of the student responses.

Uncertainties

Several uncertainties are noted here to inform readers of potential limitations when considering the results and recommendations. First, the research study was conducted during the Covid-19 pandemic, so all classes were taught either through a synchronous or asynchronous mode of online instruction. Whether this type of learning environment affected the results of the study is difficult to determine; however, it is clear that the background learning environment was not typical. Relatedly, the research team was unable to recruit as many participants as expected, and this limited the statistical analysis that could be performed (e.g., examining the role of demographics or student major area of study on the effectiveness of the transportation learning module). Another area of uncertainty was the impact of individual instructors on student responses. Although every instructor participating in the study used the same general syllabus, instructors emphasize different areas of climate science and climate solutions, and this may have affected the efficacy of the transportation learning module or impacted student opinions within the control group. A larger study over two semesters where instructors would swap between control and treatment groups for each semester would help quantify the impact of individual instructors. Finally, we also note that most of the questions had a positive bias (i.e., the answer reflecting an improved opinion of environment or transportation is reflected by "agree" or "strongly agree", except for question Q3.

"The actions of individuals will not make a difference in climate change."). This may skew the final results towards a larger impact than in reality. Future studies can avoid such potential biases by better distributing the preferred answers between "agree/strongly agree" and "disagree/strongly disagree."

5. Conclusions and Recommendations

In this study, a one-class transportation learning module was designed to encourage female students towards transportation careers through an educational experience offered within an existing university course focused on climate change. The learning module used an environmental framework to show transportation professionals as active participants in creating real-world and human-oriented solutions to climate change. Students were also introduced to female transportation professionals who were working in positions focusing on climate solutions and who shared their different career journeys. The social and human connections to environmental solutions combined with personal narratives were designed to attract female students towards more awareness and interest in transportation careers. The components of the learning module could easily be adopted by instructors of existing environmentally themed courses. The focus of this research was to evaluate the effectiveness of this type of intervention in shifting student attitudes (of any gender) about the transportation industry and transportation careers.

The experimental design focused on students taking a climate change course (METR 112: Global Climate Change) who were assigned to either a treatment group or a control group. Students in the treatment group were given a single-class transportation learning module at some point during the semester, and both groups of students completed a pre- and post-survey designed to measure student understanding and interest in transportation fields and careers. Analysis of the survey data and student written responses from the single-class transportation module provide insights into the effectiveness of the intervention.

The results of the study illustrate the potential role a short-term intervention can have on student attitudes. Through comparison of the pre- and post-module surveys, students who completed the learning module were more aware (25.2% increase in *strongly agree*) of green and sustainable careers and more aware (39.7% increase in *strongly agree*) about how the transportation industry can be a green and sustainable career. These changes in student attitudes were roughly similar between female and male students. However, when asked about considering transportation as a career option, female students from the treatment group showed an increased interest (17.5%) by the end of the course while male students in the treatment group and all students from the control group did not show a statistically significant change. Although the single-class transportation learning module represents less than 5% of the instructional time during a 15-week university course, the impacts of this experience suggest that such an approach can yield significant impacts on student learning and student attitudes.

The results of this study inform several recommendations for attracting more females to the transportation industry. These include the following.

Aligning recruitment efforts with environmental themes may help   all students including females see the social and human benefits that transportation careers offer in responding to climate and environmental challenges.

Creating 'off the shelf' educational modules that are tailored to particular courses could be attractive to instructors and effective in communicating messages about transportation careers. These modules could be created for middle school science classrooms aligned with the Human Impact standard (in the Next Generation Science Standards), for high school students in an AP Environmental Science course, and for universities within a general education setting for environmental science or climate change courses.

These findings and recommendations suggest that potentially millions of students at different formative years of their education could be reached through the development of cost-effective educational materials. A remaining challenge would be to get teachers to adopt such materials within their learning environments. Developing partnerships with existing textbook publishers may offer access to some of these students through subject-aligned integrations. Should such partnerships be established and implemented, the authors encourage stakeholders to continue to research the efficacy of this approach over time to ensure the outcomes are as expected.

Appendix A

Provided below is a copy of the survey used for the pre- and post-survey.

Global Climate Change Survey

Thank you for participating in this study. Please answer the following questions.

1) What is your name?
2) What is your SJSU email address?
3) Please select which METR class section you are enrolled in.
4) What is your gender?
   o Male (1)
   o Female (2)
   o Non-binary (3)
   o Prefer not to say (4)
   o Other (specify below) (5)
5) What is your ethnicity?
   o Caucasian (1)
   o African-American (2)
   o Latino or Hispanic (3)
   o Asian (4)
   o Native American (5)
   o Native Hawaiian or Pacific Islander (6)
   o Two or More (7)
   o Other/Unknown (8)
   o Prefer not to say (9)
6) What is your major?
7) What is your current academic year?
   o Freshman (1)
   o Sophomore (2)
   o Junior (3)
   o Senior (4)
   o 5th year or above (5)
8) I care about environmental issues.
   o Strongly agree (1)
   o Somewhat agree (2)
   o Neutral (3)
   o Somewhat disagree (4)
   o Strongly disagree (5)
9) How much do you think global warming will harm you personally?
   o A great deal (1)
   o A lot (2)
   o A moderate amount (3)
   o A little (4)
   o None at all (5)

10) The actions of individuals will not make a difference in climate change.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

11) I am aware of actions I can take to reduce climate change.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

12) I am interested in a career that works to reduce climate change.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

13) I have some understanding about green and sustainable careers.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

14) Improvements to transportation can make significant impacts on climate change.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

15) Working in the transportation industry can be a green and sustainable career choice.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

16) I would be open to working in a transportation-related career.
- o Strongly agree (1)
- o Somewhat agree (2)
- o Neutral (3)
- o Somewhat disagree (4)
- o Strongly disagree (5)

Appendix B

The writing assignment included within the transportation learning module is provided here.

For this assignment, you will watch at least three videos from the Careers for Change website and read their corresponding articles. On a separate document, answer the following:

1. Discuss the role transportation plays in climate change.

2. Of the interviews you watched, provide a concrete example of how their career has an impact on California's carbon emissions.

3. Today you watched a series of interviews about professionals in the transportation industry. Imagine a sibling, relative, or friend said they would like to pursue a career that does good for the environment. Based upon what you've learned, which career would you recommend and why?

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About the Authors

Eugene Cordero

Professor Eugene Cordero has been in the Department of Meteorology and Climate Science at SJSU for 19 years. Eugene's earlier research focused on the atmospheric variations associated with global climate change both in models and observations. More recently, Eugene shifted his focus towards solutions to climate change and this has yielded education research and collections of educational materials (i.e., curriculum, videos, games) that promote pro-environmental attitudes and behaviors in youth. One of the outcomes of this work is Green Ninja, an affiliated research group and a commercial enterprise in K–12 education that provides a platform where the results of research-based activities can be disseminated into schools to support teachers and their students. Eugene has built a strong team of researchers, educators, artists, and practitioners who together share a vision of a more sustainable future through science and education. Eugene's research activities have been supported by NSF, NASA, and MTI.

Kiana Luong

Kiana Luong is a student in San Jose State University's Animation/Illustration program with an interest in visual development and production. As a film and design student, Kiana hopes to use media to promote climate change education, sustainable living practices, and awareness of local flora and fauna. She is currently contributing to raising awareness by collaborating with a team of artists to produce a series of comics with Green Ninja, the research group founded by Professor Eugene Cordero that creates pro-environmental K–12 educational materials. Additionally, Kiana is an active member of the animation community, serving as the 2021–2022 President of the Animation/Illustration Shrunkenheadman Club and previously as the 2020–2021 Shrunkenheadman Charity Committee Moderator. Kiana holds five film credits on student produced short films and would one day like to have an environmentalist short film be screened at an international film festival.