

Fresno County Afterschool Transportation Education

Christian Wandeler, PhD
Felipe Mercado, EdD



MINETA TRANSPORTATION INSTITUTE

Founded in 1991, the Mineta Transportation Institute (MTI), an organized research and training unit in partnership with the Lucas College and Graduate School of Business at San José State University (SJSU), increases mobility for all by improving the safety, efficiency, accessibility, and convenience of our nation's transportation system. Through research, education, workforce development, and technology transfer, we help create a connected world. MTI leads the [Mineta Consortium for Transportation Mobility \(MCTM\)](#) and the [Mineta Consortium for Equitable, Efficient, and Sustainable Transportation \(MCEEST\)](#) funded by the U.S. Department of Transportation, the [California State University Transportation Consortium \(CSUTC\)](#) funded by the State of California through Senate Bill I and the Climate Change and Extreme Events Training and Research (CCEETR) Program funded by the Federal Railroad Administration. MTI focuses on three primary responsibilities:

Research

MTI conducts multi-disciplinary research focused on surface transportation that contributes to effective decision making. Research areas include: active transportation; planning and policy; security and counterterrorism; sustainable transportation and land use; transit and passenger rail; transportation engineering; transportation finance; transportation technology; and workforce and labor. MTI research publications undergo expert peer review to ensure the quality of the research.

Education and Workforce Development

To ensure the efficient movement of people and products, we must prepare a new cohort of transportation professionals who are ready to lead a more diverse, inclusive, and equitable transportation industry. To help achieve this, MTI sponsors a suite of workforce development and education opportunities. The Institute supports educational programs offered by the Lucas Graduate School of Business: a Master of Science in Transportation Management, plus graduate certificates that include High-Speed and Intercity Rail Management and Transportation Security Management. These flexible programs offer live online classes so that working transportation professionals can pursue an advanced degree regardless of their location.

Information and Technology Transfer

MTI utilizes a diverse array of dissemination methods and media to ensure research results reach those responsible for managing change. These methods include publication, seminars, workshops, websites, social media, webinars, and other technology transfer mechanisms. Additionally, MTI promotes the availability of completed research to professional organizations and works to integrate the research findings into the graduate education program. MTI's extensive collection of transportation-related publications is integrated into San José State University's world-class Martin Luther King, Jr. Library.

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the information presented herein. This document is disseminated in the interest of information exchange. MTI's research is funded, partially or entirely, by grants from the U.S. Department of Transportation, the U.S. Department of Homeland Security, the California Department of Transportation, and the California State University Office of the Chancellor, whom assume no liability for the contents or use thereof. This report does not constitute a standard specification, design standard, or regulation.

Report 24-08

Fresno County Afterschool Transportation Education

Christian Wandeler, PhD

Felipe Mercado, EdD

June 2024

A publication of the
Mineta Transportation Institute
Created by Congress in 1991

College of Business
San José State University
San José, CA 95192-0219

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. 24-08	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Fresno County Afterschool Transportation Education		5. Report Date June 2024	
		6. Performing Organization Code	
7. Authors Christian Wandeler, PhD Felipe Mercado, EdD		8. Performing Organization Report CA-MTI-2355	
9. Performing Organization Name and Address Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219		10. Work Unit No.	
		11. Contract or Grant No. ZSB12017-SJAUX	
12. Sponsoring Agency Name and Address State of California SB1 2017/2018 Trustees of the California State University Sponsored Programs Administration 401 Golden Shore, 5 th Floor Long Beach, CA 90802		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplemental Notes 10.31979/mti.2024.2355			
16. Abstract Transportation is a critical infrastructure, and K–12 students benefit from understanding the industry and how it impacts their lives. This comprehensive report investigates the landscape of transportation education via the lens of the Madera Unified School District's afterschool programs, thus highlighting its crucial role in shaping the futures of students and, consequently, society. It further explores the substantial enhancements in learning, career readiness, and societal awareness that can be achieved through the strategic incorporation of transportation concepts into K–12 education, augmented by the support of afterschool programs and online educational technologies. The study tackles challenges and explores ways to make learning engaging, using afterschool programs and online tools. Real-world examples show how this education sparks student interest and builds problem-solving skills. Ultimately, results indicate the necessity of a comprehensive approach to empower students for a sustainable and innovative future. By equipping students with the knowledge, skills, and awareness for a rapidly evolving world, educators can cultivate a well-informed, skilled, and innovative future workforce prepared to navigate the complexities of a sustainable and progressive global society.			
17. Key Words Transportation education, Transportation careers, Transportation curriculum, Afterschool activities	18. Distribution Statement No restrictions. This document is available to the public through The National Technical Information Service, Springfield, VA 22161.		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 47	22. Price

Copyright © 2024

by **Mineta Transportation Institute**

All rights reserved.

DOI: 10.31979/mti.2024.2355

Mineta Transportation Institute
College of Business
San José State University
San José, CA 95192-0219

Tel: (408) 924-7560
Fax: (408) 924-7565
Email: mineta-institute@sjsu.edu

transweb.sjsu.edu/research/2355

ACKNOWLEDGMENTS

This report represents the culmination of a collaborative journey. At this juncture, we wish to extend our deepest gratitude to all who have contributed to the success and impact of the Fresno State Transportation Institute (FSTI) program. We first acknowledge the visionary leadership and dedication of Aly Tawfik, whose commitment and expertise have been instrumental in guiding FSTI to new heights. Aly's relentless pursuit of excellence and innovative approach have significantly shaped the institute's path and success.

We extend our sincere appreciation to the entire team at Fresno State, including the Lyles College of Engineering, the Craig School of Business, and the College of Social Sciences, for their interdisciplinary collaboration and continued support. This unique partnership has been crucial in creating a comprehensive and impactful educational experience. The Fresno Council of Governments also deserves special recognition for their role in fostering community-centric transportation initiatives.

Our heartfelt thanks go to the Community Partners who have consistently created and supported enriching experiences for the students. Your engagement and resources have been vital in bringing real-world perspectives and opportunities to the educational forefront, thereby enhancing the learning journey for all participants.

We express our profound gratitude to the Madera Unified School District for their collaboration and trust in sending their students to participate in our programs. Your commitment to educational advancement and community development is deeply valued and has been a cornerstone of our program's success.

Lastly, but most importantly, we extend our deepest appreciation to the parents and the wider community who have supported this initiative every step of the way. Your encouragement, involvement, and belief in the value of transportation education have been the driving force behind our shared achievements. Together, we have created an environment where young minds can explore, innovate, and prepare for the challenges and opportunities of the future. This acknowledgment is a small token of our gratitude compared to the immense contributions each one of you has made. Together, we look forward to continuing this journey of education, innovation, and community partnership, striving towards a future where transportation is not just a means of travel but a pathway to a more connected and sustainable world.

CONTENTS

Acknowledgments.....	vi
List of Tables	ix
Executive Summary	1
1. Introduction	4
2. Background.....	5
2.1 The Case for Transportation Education in After School Programs	5
3. Literature Review.....	7
3.1 Benefits for Students	7
3.2 Benefits for Society.....	7
3.3 After School Education Programs Power to Enhance Transportation Education	7
3.4 Online Education Technology: Engagement and Future Readiness	8
4. Results.....	9
4.1 Methodology	9
4.2 Primary Qualitative Research Question.....	9
4.3 Sub-Questions	9
4.4 Facilitator and Educator Experiences	9
4.5 Facilitator and Educator Experiences	10
4.6 Student Engagement and Passion Development.....	10
4.7 Collaborative Impact	12
4.8 Overview of Lesson Plans.....	12

5. Summary & Conclusions	17
5.1 Key Research Findings of Editing the Lesson Plans for the Online Hub	17
5.2 Key Research Findings of Pilots with Self-managed Lessons	19
5.3 Key Research Findings of Pilots with After School Program	19
5.4 Limitations of the Study	19
5.5 Implications for Policy	20
5.6 Implications for Practice	20
5.7 Practical Recommendations for Transportation Education in After School	22
5.8 Next Steps	23
Appendix A.....	24
Bibliography.....	35
About the Authors	37

LIST OF TABLES

Table 1. Overview of Publishers and Sample Lesson Plan Topics.....18

Executive Summary

Embracing Transportation Education in the Modern Era

In an era marked by rapid advancements in transportation technologies and infrastructure, the integration of transportation education into K–12 curricula has emerged as a critical educational and societal imperative. As the world evolves, the future of transportation increasingly relies on the next generation’s ability to lead, innovate, and make informed decisions. This comprehensive report investigates the landscape of transportation education, highlighting its crucial role in shaping the futures of students and, consequently, society. It further explores the substantial enhancements in learning, career readiness, and societal awareness that can be achieved through the strategic incorporation of transportation concepts into K–12 education, augmented by the support of afterschool programs and online educational technologies.

Bridging the Engagement Gap

The National Transportation Career Pathways report (SETWC, 2019), alongside legislative initiatives such as California Senate Bill 1, underscores a significant engagement gap at the K–12 and community college levels. This gap restricts access to and awareness of professional careers in transportation. The programs described in the present report build upon the foundational efforts of initiatives such as the Fresno State Transportation Challenge and the Central Valley Transportation Challenge, which have pioneered methods to disseminate high-quality transportation learning experiences to a broader audience. Despite these efforts, challenges persist in integrating these resources effectively during regular school hours, necessitating additional coordination and effort from educational institutions.

Leveraging Afterschool Programs and Online Technologies

Afterschool programs present a viable solution, offering the necessary flexibility and quality to enhance transportation education. These programs not only provide opportunities for transportation-related activities but also seek quality learning experiences that extend beyond mere supervision. Online education technology complements this approach by offering interactive, student-centered learning experiences catering to individual needs and fostering essential 21st-century skills. The present study evaluated the use of an online hub with lesson plans and designed transportation-related lessons that were geared to be completed in a self-managed fashion. A key insight was that in order for self-managed lessons to be successful there still needs to be an interaction taking place with a facilitator and someone who connects the students with the online lesson hub in a meaningful way.

Examples of the Topics chosen for the Lesson Plans

Incorporating a diverse range of educational activities, the lessons provided offer a comprehensive exploration of transportation-related topics essential for students' understanding of urban planning and societal dynamics. The lesson topics vary from Urban Planning and Transportation Design, the History of Transportation, Global Transportation Networks, Technology in Transportation, and Transportation and Society that delve into social aspects such as accessibility and equity. These topics were chosen to cover a breadth of areas and provide an opportunity to tap into diverse student interests illustrate, while at the same time also showcasing how a variety of topics and ultimately careers can be related to transportation.

Assessing Impact on Students and Society

A comprehensive literature review reveals the profound impact of transportation education in K–12 on students and society. Early exposure to transportation topics significantly bolsters career readiness and kindles interest in relevant careers, addressing future workforce needs. The integration of transportation into education not only strengthens STEM skills and critical thinking but also fosters an awareness of transportation's societal impact, thus promoting civic responsibility and sustainable living. Additionally, the societal benefits, including fostering environmentally conscious decision-making and enhancing economic stability through a knowledgeable workforce, are equally significant.

Role of Afterschool Programs and Online Education

Afterschool programs are identified as critical in extending learning opportunities and notably enhancing transportation education. They provide a platform for targeted interventions and extended learning time, enabling students to deeply explore complex transportation concepts. The inherent flexibility in these programs encourages innovative and engaging program designs and fosters community engagement. Conversely, online education technology revolutionizes learning by aligning it with the requisite skills for the 21st century, promoting interactive, personalized learning and fostering essential skills such as digital literacy and adaptability.

Charting a Path to Future Preparedness

The integration of transportation education into K–12, combined with the leveraging of afterschool programs and online education technologies, creates a comprehensive approach to preparing students for the future. This strategy not only enhances individual learning and career readiness but also contributes to broader societal goals of economic growth and sustainable development. An understanding of the policies and research that shape these educational strategies provides invaluable insights into their potential and challenges, thereby guiding effective implementation and development. This holistic approach is crucial for integrating transportation

education with innovative learning methods, thereby preparing students for the complex challenges and opportunities that the future holds.

Implications for Practice

Enhancing Educational Engagement: The National Transportation Career Pathways report identifies an engagement gap in K–12 and community college levels, recommending integration of transportation education into standard curricula. Expanding initiatives such as California Senate Bill 1 is crucial for supporting workforce education in transportation.

Promoting Collaborative Educational Models: Success stories such as the Fresno State and Central Valley Transportation Challenges highlight the effectiveness of collaborative, project-based learning. Policies should encourage partnerships between schools, industry, and community organizations to create relevant and engaging hands-on learning experiences.

Fostering Innovative Educational Technologies: Integrating online education technologies is essential for 21st-century skill development. Policies should support the development and integration of these technologies into transportation education, fostering interactive and personalized learning experiences.

Curriculum Development: Institutions should develop curricula integrating transportation concepts with a focus on real-world applicability, problem-solving, and critical thinking skills.

Professional Development: Educators require training and resources to effectively deliver transportation education, including understanding advancements in transportation technology and sustainability practices.

Community and Industry Engagement: Schools should seek partnerships with local government, transportation agencies, and industry professionals to provide real-world exposure and learning opportunities.

Evaluation and Adaptation: Continuous evaluation and feedback mechanisms are crucial to adapt and improve transportation education programs, involving students, educators, and industry partners through surveys, focus groups, and adaptive learning technologies.

1. Introduction

As the world navigates through an era of rapid transformation in transportation technologies and infrastructure, the imperative to integrate transportation education into K–12 curricula has never been more critical. The future of transportation is not just about the development of new technologies and systems but also about preparing the next generation to lead, innovate, and make informed decisions about the transportation networks that underpin our society and economy. This research report delves into the current landscape of transportation education and its pivotal role in shaping students' futures and societal outcomes. It explores how strategic integration of transportation concepts into K–12 education, coupled with the support of afterschool programs and online educational technologies, can significantly enhance learning, career readiness, and societal awareness.

The foundation of this report is the examination of the relevance and necessity of transportation education, as highlighted by various studies and legislative acts. The National Transportation Career Pathways report (SETWC, 2019) and California Senate Bill 1 (Road Repair and Accountability Act of 2017) spotlight the existing engagement gap at the educational level and the need for dedicated funding for transportation-related workforce education. Initiatives such as the Fresno State Transportation Challenge and the Central Valley Transportation Challenge have pioneered methods to deliver high-quality transportation learning experiences to a broader student demographic. Yet, challenges remain in fully integrating these resources into the school day, necessitating additional coordination and effort from educational institutions.

This report transitions into a literature review synthesizing research and insights on the impact of transportation education in K–12 on students and society, the role of afterschool education programs in enhancing transportation learning, and the contribution of online education technology in ensuring engagement and future readiness. Each component plays a critical role in forming a comprehensive approach to transportation education that is responsive to the needs of the modern world and anticipatory of future challenges and opportunities in the transportation sector.

This report aims to provide an in-depth understanding of the current state, potential, and direction for transportation education in the K–12 sector. It seeks to offer valuable insights for educators, policymakers, and industry leaders on implementing effective strategies and policies that will cultivate a well-informed, skilled, and innovative future workforce capable of driving sustainable and progressive transportation systems worldwide.

2. Background

2.1 The Case for Transportation Education in Afterschool Programs

Enhancing K–12 education critically hinges on the question: why should afterschool programs integrate transportation-related education? The answer is multifaceted: addressing systemic gaps, enhancing academic achievement, and preparing youth for future opportunities.

The National Transportation Career Pathways report (Southeast Transportation Workforce Center [SETWC], 2019) highlights the critical lack of engagement at the K–12 and community college levels, which restricts awareness and access to professional careers in transportation. This educational and societal gap necessitates programs that not only inform but also inspire students to pursue transportation careers. The legislative response, such as California Senate Bill 1, allocates funding to transportation-related workforce education, emphasizing the urgency of this need.

The After School Education and Safety (ASES) Program and the 21st Century Community Learning Centers (CCLC) Program present compelling solutions. Funded and supported by the California Department of Education (CDE), these programs are designed to offer safe and educationally enriching alternatives for children and youths during non-school hours (California Department of Education, n.d.). Focused on academic achievement, enrichment services, and family literacy, these programs are well-positioned to integrate transportation education into their curricula, addressing the engagement gap highlighted by SETWC (2019).

Past projects such as the Fresno State Transportation Challenge (Wandeler, Hart & Mercado, 2019) and the Central Valley Transportation Challenge (CVTC) (Wandeler & Hart, 2022) have demonstrated the feasibility and benefits of integrating transportation education into afterschool settings, particularly for underserved rural communities. However, ensuring the full utilization of these resources remains a challenge. Afterschool programs, with their flexibility and focus on additional academic support, provide an ideal setting to overcome these barriers. They offer the time, resources, and hands-on experiential learning opportunities necessary for students to engage deeply with transportation concepts, thereby significantly enhancing the quality and reach of transportation education.

There are some limitations and disadvantages of transportation-related education such as time, cost, and expertise. More often than not, teachers do not have transportation-related education on their radar, and thus bringing in transportation experts or external facilitators is not a sustainable model. This is one of the reasons this study focuses on afterschool programs.

Afterschool programs should integrate transportation-related education to bridge the engagement gap in transportation careers, enhance academic achievement, and equip students with the skills and knowledge necessary for future opportunities. Through funding opportunities such as ASES

and 21st CCLC and successful models from prior initiatives, afterschool programs have the potential to transform the landscape of transportation education and make it accessible to students everywhere. This comprehensive approach is essential for preparing students for the complexities of the future and contributing to a more informed, skilled, and passionate future workforce.

3. Literature Review

The strategic integration of transportation education into K–12 curricula is increasingly recognized as a critical method to enrich student learning and prepare them for future societal challenges. This literature review systematically explores the many benefits this integration offers, profoundly impacting both individual student development and society at large.

3.1 Benefits for Students

The introduction of transportation topics early in education significantly enhances career readiness by sparking interest in related careers, thus proactively addressing the future workforce needs in this vital sector. Garrett (2018) provides empirical support, noting that students exposed to transportation careers are more likely to consider these paths, indicating the sector’s potential to inspire future professionals. Furthermore, integrating transportation into education enhances STEM skills, cultivating critical thinking and problem-solving abilities that are crucial in today’s rapidly evolving world (National Research Council, 2015). This educational engagement not only bolsters students’ academic prowess but also heightens their awareness of transportation’s societal impact, promoting a sense of civic responsibility and sustainable living (McKee, 2017).

3.2 Benefits for Society

The societal advantages of incorporating transportation education are equally compelling. Educating the younger generation about sustainable transportation practices fosters environmentally conscious decision-making (Litman, 2020), crucial in the face of global ecological challenges. Moreover, a knowledgeable workforce is vital for maintaining and innovating transportation infrastructure, which in turn boosts economic stability and growth (Rodrigue, 2017). These benefits collectively contribute to a more sustainable, informed, and forward-thinking society.

3.3 Afterschool Programs’ Power to Enhance Transportation Education

Afterschool programs play a pivotal role in extending learning opportunities and significantly enhancing transportation education. These programs offer a platform for enhanced learning opportunities through extended learning time, allowing students to delve deeply into complex transportation concepts (Afterschool Alliance, 2020). They provide targeted interventions, benefiting students from diverse backgrounds, particularly those in high-need areas (Afterschool Alliance, 2020). The inherent flexibility in these programs promotes innovative and hands-on program designs, supported by policies such as the Every Student Succeeds Act (ESSA) (Fashola, 1998). Additionally, these programs often engage in partnerships with local entities, fostering community engagement and providing comprehensive services (Little, Wimer, & Weiss, 2008), thereby creating a rich, contextual learning environment.

3.4 Online Education Technology: Engagement and Future Readiness

The advent of online education technologies has revolutionized the learning landscape, aligning education with the essential skills required for the 21st century. Interactive tools, such as digital simulations, enhance learning engagement, transforming education into an active, student-centered experience (U.S. Department of Education, 2017). Personalized learning paths supported by technology cater to individual student needs, preparing them for future challenges (Honey & Hilton, 2011). Additionally, these technologies foster critical 21st-century skills, such as digital literacy and adaptability (Voogt et al., 2013), promoting a culture of continuous learning and innovation (Bates, 2019), essential in a rapidly changing world.

Integrating transportation education into K–12 curricula, leveraging the unique advantages of afterschool programs, and utilizing the potential of online education technologies together create a comprehensive approach to preparing students for the future. This multifaceted strategy not only enhances individual learning and career readiness but also contributes to broader societal goals of economic growth and sustainable development. A thorough understanding of the policies and research that shape these educational strategies provides comprehensive insight into their potential and their challenges, guiding effective implementation and development. This holistic approach underscores the necessity of integrating innovative learning methods with transportation education to prepare students for the complexities of the future, ensuring they are well-informed, skilled, and ready to contribute to a progressive and sustainable world.

The importance of making transportation-related education more sustainable, leveraging afterschool programs, and utilizing technology is what lead to the overarching research question: how can transportation related education become more self-managed by students?

4. Results

4.1 Methodology

This study employed a comprehensive qualitative methodology to derive nuanced insights into the implementation and outcomes of the transportation education initiative. The research design was centered around the experiential knowledge of a facilitator, who is also a former principal and current professor, working within the afterschool programs at the Madera Unified School District. This particular district was chosen because of its student demographic. We wanted to work with students from a rural and typically underserved background. Data were collected using multiple approaches, including detailed observations, reflective journals maintained by the facilitator, and semi-structured interviews conducted with a purposive sample of students, educators, and the facilitator. A rigorous thematic analysis was conducted to identify and interpret patterns and insights related to the delivery and impact of the transportation education initiative.

4.2 Primary Qualitative Research Question

How does the facilitation of transportation education within afterschool programs impact the cultivation of passion and the enhancement of problem-solving skills among middle and high school students in the Madera Unified School District?

4.3 Sub-Questions

- In what ways do the experiences of a facilitator (who in this case is a former principal and current professor) shape the implementation and effectiveness of transportation education in afterschool programs?
- Through what mechanisms does the process of devising solutions to intricate transportation issues foster a passion for learning among students?
- What are the perceived effects of collaborative lesson creation and experiential learning on the academic and personal development of both students and educators?

4.4 Facilitator and Educator Experiences

This study employed a collaborative lesson creation approach within an afterschool transportation education program. A facilitator with experience as a principal and professor played a dual role of guiding educators during lesson development and observing their contributions. This active guidance involved providing constructive feedback, scaffolding learning experiences to support educator understanding, and fostering innovation in lesson design. Guidance encompassed various strategies: offering feedback on lesson content and pedagogy, suggesting resources, and

encouraging educators to tailor lessons to student interests and local transportation needs. Observation focused on gauging the dynamics of interaction within the collaborative process, the effectiveness of pedagogical strategies employed by educators, and student engagement levels.

This dual role of guiding and observing facilitated a deeper understanding of the experiential learning process. By observing both lesson delivery and student reception, the facilitator gained valuable insights into the effectiveness of the collaborative approach. This comprehensive perspective allowed for adjustments to be made throughout the program, ensuring successful curriculum implementation.

4.5 Student Engagement and Passion Development

Participants were selected from the afterschool programs within the Madera Unified School District, which serves a predominantly rural and underserved student population. The purposive sample includes students engaged in transportation-related afterschool activities, educators responsible for delivering the curriculum, and the key facilitator—a former principal and current professor—who plays a central role in the program’s implementation.

The project engaged 30 middle school students and 20 high school students across five transportation-related lesson plans, conducted weekly for 1.5 hours over a semester. This structured approach was designed to foster sustained interest and participation, with students displaying increased curiosity and a proactive approach to complex transportation issues. Particularly noteworthy were instances where students, previously disengaged, became actively involved in projects with direct community impact, highlighting the role of contextual education in fostering relevance and ownership among students.

4.6 Data Collection Methods

This investigation adopted a multi-method qualitative approach to deeply understand the impacts of an afterschool transportation education program on students’ enthusiasm for transportation topics and their ability to solve problems. This methodological framework aimed to capture the rich, lived experiences and perceptions of all the program’s participants.

Targeted systematic observations were carried out during the afterschool program sessions. The observers focused on measuring student engagement, their interactions with the educational content, and participation in collaborative problem-solving activities. Questions were designed to be open-ended to elicit detailed responses about students’ engagement, learning experiences, and perspectives on transportation topics. The design focused on capturing qualitative insights into students’ emotional and intellectual reactions to the lessons. Observers meticulously recorded detailed field notes to document the learning environment’s dynamics, with a specific emphasis on identifying how instructional strategies encouraged student interest in transportation and nurtured their problem-solving capabilities.

To gain deeper insights into individual experiences, semi-structured interviews were conducted with students, educators, and the program facilitator. The interview protocol was designed to probe the extent to which involvement in the program spurred a passion for transportation among students and influenced their problem-solving skill development. Interviews with educators and the facilitator further sought to uncover insights into the program's goals, the strategies implemented, and the educators' perceptions of the program's impact on student learning outcomes. Interviews with students, educators, and the facilitator were structured around key topics while allowing for exploratory discussions. Questions probed the impact of the initiative on participants' interest in transportation and its challenges, the development of problem-solving skills, and perceptions of the program's relevance to their lives and communities.

The facilitator and educators were encouraged to keep reflective journals throughout the duration of the program. These journals were invaluable in capturing their continuous observations on student progress, the efficacy of the teaching methods employed, and their personal reflections on how the program affected students' passion for transportation and their problem-solving skills.

Data Analysis

The study applied a comprehensive thematic analysis to the observational notes, interview transcripts, and entries from reflective journals. The thematic analysis was iterative, allowing themes to emerge organically from the data. Initial codes were generated from observations, journal entries, and interview transcripts, grouped into potential themes which were then reviewed and refined. The primary goal was to identify and interpret recurring themes that illuminated the program's impact on fostering student passion for transportation and enhancing problem-solving abilities. Initial coding involved meticulously identifying and tagging significant text segments directly related to the research questions. These identified segments were coded based on their thematic content, facilitating the thematic emergence from the collated data.

Following coding, the research team engaged in a rigorous process of grouping coded segments into overarching themes. Through iterative review and discussion, themes were refined to ensure they accurately represented the data and were coherent with the research questions. This iterative process culminated in a thematic framework encapsulating the program's nuanced effects on student engagement and learning. To ensure credibility within this study and address potential bias, a strategy of data triangulation was implemented. Insights gleaned from the various data sources—observational notes, interviews, and journals—were cross-examined, ensuring that the findings were robust, well-supported, and reflective of a multiplicity of perspectives.

Ethics and Bias Mitigation

Ethical considerations, particularly regarding the participation of minors, were addressed through informed consent from parents or guardians and adherence to confidentiality and anonymity in

reporting the findings. To avoid bias towards positive results, the study employed data triangulation, comparing observations, interview data, and journal entries for consistency. Additionally, the study maintained an openness to negative or neutral findings, ensuring a balanced view of the program's impact.

4.7 Collaborative Impact

This study explored the role of student-educator collaboration in co-creating lessons and experiences within an afterschool transportation education program. The program emphasized a collaborative approach, where students and educators worked together to develop the curriculum. This collaborative process fostered dynamic and student-responsive learning experiences, leading to increased student interest and participation. Observations suggest that students felt their contributions were valued, potentially leading to a stronger sense of ownership and relevance in their learning.

The program's focus on transportation education within afterschool programs at the Madera Unified School District aimed to ignite passion, foster engagement, and enhance problem-solving skills among middle and high school students. The facilitator's experience, combined with the emphasis on collaborative lesson creation and real-world application, likely contributed to an enriched learning environment (Bruner, 1960). This environment may have increased student motivation to learn and potentially improved their ability to tackle complex transportation issues. These findings suggest that afterschool programs can be a valuable platform for introducing and nurturing student interest in STEM fields, including transportation. Collaborative lesson creation, coupled with real-world application, has the potential to cultivate a more informed, adept, and passionate future workforce (National Academies of Sciences, Engineering, and Medicine, 2018).

4.8 Overview of Lesson Plans

The study engaged students in five transportation-related lesson plans: Urban Planning and Transportation Design, History of Transportation, Global Transportation Networks, Technology in Transportation, and Transportation and Society. Thirty middle school students and twenty high school students participated. Sessions were held weekly, lasting 1.5 hours over a semester. This structured yet diverse curriculum aimed to cover a broad spectrum of transportation-related topics, encouraging sustained engagement and curiosity.

(1) Urban Planning and Transportation Design:

(a) Objective: Introduce students to the basics of urban planning and how transportation design affects city layout and daily life.

(b) Activities:

- (i) Virtual city tour, highlighting different transportation systems and their impact on urban development.
- (ii) Interactive activity, where students design their ideal city with various transportation options.
- (iii) Discussion on how transportation design can improve community living and reduce congestion.

(2) History of Transportation:

- (a) Objective: Explore the evolution of transportation from ancient times to the present day, understanding how historical advancements have shaped modern systems.
- (b) Activities:
 - (i) Timeline project, tracing the development of transportation methods over time.
 - (ii) Case studies on significant innovations such as the steam engine, automobile, and airplane.
 - (iii) Video series on the history of transportation with reflective questions for students.

(3) Global Transportation Networks:

- (a) Objective: Provide insights into how global transportation networks operate, including trade routes, international aviation, and shipping.
- (b) Activities:
 - (i) Interactive map exercises, identifying major global transportation hubs and routes.
 - (ii) Discussions on the importance of international transportation for global trade and economy.
 - (iii) Case study on the impact of transportation disruptions on global supply chains.

(4) Technology in Transportation:

- (a) Objective: Discuss current and emerging technologies in transportation, such as electric vehicles, autonomous cars, and smart infrastructure.

(b) Activities:

- (i) Research and presentation on a specific transportation technology.
- (ii) Stimulation and modeling activities using computer-based simulations or model-building activities related to transportation technologies.
- (iii) Debate the benefits and challenges of adopting new transportation technologies.

(5) Transportation and Society:

(a) Objective: Examine the social aspects of transportation, including accessibility, equity, and community impact.

(b) Activities:

- (i) Survey project, assessing transportation needs and challenges in their community.
- (ii) Role-playing activities, exploring different perspectives on transportation issues (e.g., a city planner, a disabled individual, a transportation worker).
- (iii) Plan and propose a community project aimed at improving local transportation.

4.9 Piloting the Complementary Self-Managed Lessons in Afterschool Programs

(1) Preparation:

- (a) Ensure each lesson has clear instructions and materials available online or in a format easily accessible to students.
- (b) Provide a guide for afterschool staff to help facilitate discussions and activities.

(2) Implementation:

- (a) Integrate these lessons with the original transportation series for a comprehensive understanding.
- (b) Encourage students to take the lead in discussions, presentations, and activities to foster a sense of ownership and engagement.

(3) Feedback & Evaluation:

- (a) Use surveys and informal discussions to gather student feedback on the relevance and engagement of each lesson.
- (b) Monitor progress and understanding through quizzes or reflective journals.
- (c) Continually refine the lessons based on student and staff input to ensure they remain relevant, informative, and engaging.

Through a carefully curated blend of experiential learning activities, these plans engage students in immersive and interactive experiences, from virtual city tours to dynamic role-playing exercises. Such activities are not merely educational tools; they are foundational to cultivating a lasting passion for transportation and significantly enhancing students' problem-solving abilities. At the heart of these lesson plans is a commitment to real-world application. Activities, notably the community project proposal outlined in Lesson 5, serve as direct conduits for engaging students with the tangible transportation issues their communities face. This approach not only aligns with our study's objective to bolster problem-solving skills but also ensures that students' learning is deeply relevant and immediately applicable to their lived experiences.

Spanning a broad spectrum of topics, from the historical evolution of transportation to its latest technological advancements, the lesson plans offer students a holistic view of the field. This breadth of content, enriched by an interdisciplinary approach that weaves together geography, history, technology, and social studies, promotes a multidisciplinary understanding of transportation issues, preparing students to think critically about these challenges from multiple perspectives. With clear objectives and detailed activities, each lesson is crafted for ease of replication across diverse educational settings. The inclusion of all necessary materials in accessible formats further supports this replicability. Moreover, the practicality of the proposed activities, which leverage widely available technology and resources, underscores the feasibility of these lesson plans, making them a valuable asset for any afterschool program.

To augment the effectiveness of these lesson plans, we recommend the incorporation of assessment rubrics for each activity, enhancing the comprehensiveness of student evaluations. Additionally, increasing community engagement across all lessons and ensuring technological accessibility are pivotal steps toward enriching students' learning experiences and broadening their understanding of transportation's role in society. The detailed lesson plans are provided in the Appendix section of this report. These plans are not only a testament to the innovative approach of integrating transportation education into afterschool programs but also serve as a blueprint for educators seeking to replicate this success in their own classrooms. By following these guidelines and recommendations, we can significantly enhance the educational landscape of transportation studies, inspiring the next generation of thinkers, innovators, and leaders in the field.

Addressing Methodological Considerations

In addressing the design of survey/observation questions and semi-structured interviews, the study ensured questions were open-ended to capture in-depth insights into participants' experiences and perceptions. The thematic analysis was performed iteratively, allowing themes to emerge organically from the data, thereby maintaining analytical rigor and reducing bias. Future directions, including the potential for a randomized controlled trial (RCT), highlight the study's commitment to further validating the educational impacts of transportation-related lesson plans compared to traditional and other hands-on learning methods. Proposing an RCT comparing the efficacy of transportation-related lesson plans with traditional learning and other types of hands-on lessons can provide quantifiable data on student engagement, knowledge acquisition, and interest in transportation careers. The study and subsequent analysis are directly aimed at understanding how transportation education in an afterschool setting impacts student passion for transportation and problem-solving skills. By employing a comprehensive qualitative approach, the study captures the nuanced experiences of all 26 participants, offering in-depth insights into the educational and transformative potential of the program.

5. Summary & Conclusions

As we steer into an era of significant advancements in transportation technologies and infrastructure, the integration of transportation education into K–12 curricula is imperative. This report highlights the necessity of such integration, focusing on its potential to enhance learning, career readiness, and societal awareness. It also emphasizes the role of afterschool programs and online technologies in reinforcing this educational framework.

5.1 Key Research Findings of Editing the Lesson Plans for the Online Hub

The Fresno State Transportation Institute has collected about 100 lesson plans from various sources (see Table 1 for an overview). We worked with afterschool curriculum experts to transfer these plans onto the online lesson plan hub to make them accessible to afterschool programs and other educators. A main focus for a successful afterschool program lesson is the level of student engagement. Lessons with high levels of activity are preferred. The format of the lesson plans and the information provided varied widely depending on the resources and took more time than anticipated to be reviewed. Presentation at the California Education Research Conference in November 2023 led to interest from various school districts.

Table 1. Overview of Publishers and Sample Lesson Plan Topics

Publisher	Number of Lessons	Sample Lesson Topics
Fresno State Transportation Institute	6	A Step Towards Sustainable Development in Transportation Designing Different Highway Interchanges Intersection Safety and Management (Longer or Shorter) Transportation and Climate Change Action Hour Various Modes of Transportation
DiscoverE	11	Rubber Band Rover, Puff Mobiles, Levitating Train, Build a Roller Coaster
The Institute of Transportation Engineers	19	Traffic Counts and Signal Timing, Intersection Safety, Pedestrian Signal Timing Traffic Engineering Equipment Analyzing, Traffic Counts of an Intersection
Fresno State Transportation Institute	19	Impact of Traffic Lights on Traffic Flow, Autonomous Vehicles and Human Behavior, the Pros and Cons of Hybrid Vehicles
University of Minnesota	4	
ASCE	22	LiDAR Mapping, Highway Interchanges, Robot Challenge
IEEE	10	Design Drones, Take Flight, Speedboat
Teach Engineering https://www.teachengineering.org/	4	Cars from the Future: Presenting Your Eco-Friendly Design Ideas, Let's Get It There Fast, Particulate Matter: For Your Eyes Only, Green Marketing
WUP center	6	Train Lessons, Car Lessons

5.2 Key Research Findings of Pilots with Self-Managed Lessons

The initial idea behind developing self-managed lessons was to make transportation-related content widely available to students, independent of instructors or facilitators. A key insight was that in order for self-managed lessons to be successful, there still needs to be an interaction taking place with a facilitator and someone who connects the students with the online lesson hub in a

meaningful way. We arrived at this conclusion based on our observations of the afterschool lessons and interviews with the afterschool staff. The afterschool programs often require quite a bit of classroom management skills from the staff. Staff commented it is not enough to provide them with access to resources such as the online hub. Many students need to be actively guided to stay focused on the task.

5.3 Key Research Findings of Pilots with Afterschool Program

A main focus for a successful afterschool program lesson is the level of student engagement. When working with afterschool programs, a key finding was how important the classroom management skills of the afterschool staff are and how much importance rests in the self-regulation skills of the students. We concluded that the target group for the more complex lessons should be moved from middle school students to high school students.

We also determined that classroom management and self-regulation training would be a crucial first step before training afterschool provider staff in the use of the transportation-related lessons on the online hub. It may be possible to leverage existing programs that train afterschool staff in classroom management.

5.4 Limitations of the Study

A primary constraint of our study was the setting—the Madera Unified School District, a predominantly rural area with a diverse, underserved student population. This specificity, while offering valuable insights into the applicability of transportation education in less urbanized contexts, may limit the generalizability of our findings. Rural settings often present unique challenges and opportunities, such as limited access to advanced technological resources or direct exposure to transportation infrastructure projects, which might not be reflective of more urban environments where students could have varied interaction levels with the lessons.

Moreover, the reliance on afterschool programs as the primary delivery mechanism for transportation education introduces another layer of complexity. Afterschool environments vary significantly in terms of resources, student engagement levels, and educator expertise. Our study's focus on self-regulated learning highlighted the critical role of facilitation, yet the degree of independence with which students can engage with the material may fluctuate widely across different settings and age groups.

Overall it seemed like the content chosen was a sturdy test for the lessons in an environment that in the end also represents the population that we strive to target to increase the chances of equitable access to transportation education and ultimately careers. These contextual nuances underscore the need for adaptive strategies when implementing transportation education curricula across diverse educational landscapes. Addressing these limitations opens avenues for further research,

particularly in exploring the efficacy of transportation education in urban settings and its impact on different student demographics.

5.5 Implications for Policy

Enhancing Educational Engagement

- The National Transportation Career Pathways report (SETWC, 2019) points out the engagement gap at the K–12 and community college levels. Students are typically not exposed to careers related to transportation. Policymakers should consider strategies to integrate transportation education into standard curricula to bridge this gap. Initiatives such as California Senate Bill 1, which provides dedicated funding for transportation-related workforce education (California Senate Bill 1, 2017), should be expanded and replicated to support these efforts.
- Policy recommendations include the development of state and federal funding programs, similar to the ASES and 21st Century Community Learning Centers (CCLC) Programs, which support afterschool education with a focus on real-world applicability and skill development (California Department of Education, n.d.).

Promoting Collaborative Educational Models

- The success of programs such as the Fresno State Transportation Challenge (Wandeler, Hart & Mercado, 2019) and the Central Valley Transportation Challenge (Wandeler & Hart, 2022) demonstrates the effectiveness of collaborative, project-based learning. Policies should encourage partnerships between schools, industry, and community organizations to create hands-on learning experiences that are both relevant and engaging.

Fostering Innovative Educational Technologies

- The integration of online education technologies, as noted in the U.S. Department of Education’s National Education Technology Plan (U.S. Department of Education, 2017), is vital for 21st-century skill development. Policies should support the development and integration of these technologies into transportation education, promoting interactive, personalized learning experiences.

5.6 Implications for Practice

Curriculum Development

- Schools and educational institutions should develop curricula that integrate transportation concepts, focusing on real-world applicability, problem-solving, and critical thinking skills.

This can be achieved by incorporating case studies, interactive simulations, and project-based learning strategies into existing STEM programs.

Professional Development

- Educators should receive training and resources to effectively deliver transportation education. This includes understanding the latest advancements in transportation technology, urban planning, and sustainability practices. Partnerships with industry professionals and ongoing professional development opportunities can enhance educators' ability to provide relevant and up-to-date information.

Community and Industry Engagement

- Schools should actively seek partnerships with local government, transportation agencies, and industry professionals to provide students with real-world exposure and learning opportunities. This could include guest lectures, site visits, internships, and collaborative projects aimed at solving local transportation challenges.

Evaluation and Adaptation

- Continual evaluation of transportation education programs is crucial. Feedback mechanisms should be established to gather insights from students, educators, and industry partners to continually adapt and improve the curriculum. This might involve regular surveys, focus groups, and the integration of adaptive learning technologies to track and respond to student progress.

The strategic integration of transportation education into K–12 curricula, supported by afterschool programs and online educational technologies, offers a comprehensive approach to preparing students for future societal and professional challenges. Policymakers and educators must collaborate to develop and implement policies and practices that support this integration, thereby ensuring that students are well-equipped with the knowledge, skills, and innovative thinking required for the future of transportation and beyond. This holistic approach not only enhances individual learning and career readiness but also contributes to broader societal goals of economic growth, environmental sustainability, and sustainable development.

5.7 Practical Recommendations for Transportation Education in Afterschool Programs

Engaging students in afterschool programs involves creating an environment that is not only educational but also enjoyable and meaningful. Here are some strategies to keep in mind when engaging students in transportation-related education in afterschool programs.

Interactive and Hands-On Activities

Plan activities that involve hands-on learning, experiments, or projects. Interactive experiences can make the learning process more engaging.

Student Choice and Input

Allow students to have a say in the activities or topics covered. When they have a sense of ownership, they are more likely to be engaged. The synergy between students and educators in co-creating lessons and experiences emerged is a pivotal element in the program's success.

Incorporate Technology

Integrate technology into your activities, such as educational games, online resources, or interactive multimedia presentations. Many students find technology to be a motivating factor.

Collaborative Learning

Foster a collaborative learning environment. Group activities, discussions, and projects encourage teamwork and social interaction.

Real-World Relevance

Relate the content to real-world scenarios. When students understand the practical applications of what they're learning, they are more likely to stay engaged. That is why transportation is such a great topic.

Variety in Activities

Keep the activities diverse. Rotate between different types of activities to cater to different interests and learning styles.

Incorporate Art and Creativity

Include art, music, drama, or other creative activities. These not only provide a break from traditional learning but also tap into different forms of intelligence.

Physical Activities

Incorporate physical activities or sports. Movement can help break up the monotony and keep students energized.

Positive Reinforcement

Recognize and reward students for their achievements. Positive reinforcement can motivate them to actively participate and excel.

Guest Speakers and Field Trips

Bring in guest speakers or organize field trips to expose students to different perspectives and real-world experiences. For example, in the Fresno area, there are a variety of opportunities: collaboration with High-Speed Rail, Caltrans, Bike Coalition, etc. The connection to transportation professionals and industry representatives is an effective way to underline the real-life impact of transportation-related careers.

5.8 Next Steps

The study was presented in November 2023 at the California Educational Research Association. The next steps include more dissemination of results for researchers and practitioners. The aspiration is to also recruit more afterschool programs to use the lessons and provide transportation related education.

Appendix A

Lesson Plans

Lesson 1: Urban Planning and Transportation Design

Objective: Equip students with an understanding of urban planning principles and the impact of transportation design on city life and the environment.

Materials Needed

Access to computer labs with simulation software (e.g., SimCity, Cities: Skylines, or any urban planning simulation tool available through educational licenses).

Procedure:

- **Introduction to Software:** Begin with a brief tutorial on how to use the simulation software. Highlight features that allow for the manipulation of transportation systems and the observation of their impacts on urban environments.
- **Assignment:** Assign students the task of improving traffic flow and public transportation efficiency in a given area within the simulation. Provide scenarios that require them to integrate different transportation technologies, like bike lanes, electric vehicle charging stations, or autonomous bus routes.
- **Observation and Analysis:** Encourage students to observe the changes in traffic patterns, pollution levels, and citizen satisfaction within the simulation as they implement various transportation solutions.

Interactive Design Activity

Materials Needed: Digital tools (urban planning apps or software) or paper materials (graph paper, colored pencils, rulers).

Procedure:

- **Design Brief:** After the simulation activity, challenge students to design their ideal city on a blank slate, incorporating a comprehensive transportation system. Emphasize the importance of diverse transportation options to cater to different community needs.

- **Collaboration:** Encourage students to work in small groups, fostering collaboration. Each group should think about including elements such as pedestrian pathways, bike lanes, public transit, and green spaces within their city designs.
- **Consideration:** Ask students to consider and incorporate aspects like accessibility for the disabled, economic feasibility, and environmental sustainability in their designs.

Discussion

Focus Points:

- **Design Impact:** Initiate a discussion on how different transportation designs can significantly affect urban living, focusing on aspects like congestion reduction and environmental health.
- **Real-world Examples:** Bring in case studies of cities that have successfully implemented innovative transportation systems (e.g., Copenhagen's bike lanes, Singapore's electronic road pricing).
- **Challenges:** Discuss potential challenges cities face when trying to implement new transportation solutions, such as budget constraints, public resistance, or geographical limitations.

Evaluation

Presentation: Have students present their city designs to the class, explaining their transportation choices and how those choices impact urban development, community living, and environmental health.

Discussion Participation: Evaluate students on their active participation in discussions, assessing their understanding of transportation design principles, and their ability to critically analyze and compare different transportation solutions.

Lesson 1 lays the groundwork for a deeper exploration of the historical advancements in transportation, by focusing on the principles of urban planning and transportation design. This structure ensures a logical progression into Lesson 2, where students will further investigate how past innovations have influenced current urban planning strategies and societal developments, enriching their overall understanding of the field.

Lesson 2: History of Transportation

Objective: To provide students with an in-depth look at the historical development of transportation technologies and how these advancements have shaped current urban systems and societal dynamics.

Materials Needed

Access to research tools (internet, library resources), multimedia creation tools (digital timeline software or traditional poster materials), and historical transportation documentaries or articles.

Procedure:

- **Research Phase:** Guide students to conduct research on key transportation milestones, starting from ancient methods (like the invention of the wheel) to modern advancements (like electric vehicles and high-speed trains). Encourage the use of diverse sources, including books, academic journals, and reputable online content.
- **Timeline Creation:** Students can use digital timeline software (e.g., Tiki-Toki, Timetoast) or traditional materials to create their timelines. Each entry on the timeline should include the date of the innovation, a brief description, and its impact on society.
- **Presentation:** Students present their timelines to the class, highlighting a few key innovations that they found most impactful. Encourage them to explain how these developments contributed to changes in urban planning, economic growth, or societal shifts.

Case Studies

Materials Needed: Selections of documentaries, articles, and reports on significant transportation innovations such as the steam engine, automobile, and airplane.

Procedure:

- **Group Work:** Divide students into small groups, assigning each a different transportation innovation to explore.
- **Analysis:** Each group analyzes their assigned case, focusing on the context of the innovation, the problem it solved, and its broader implications for society and urban development.

- **Group Presentation:** Groups present their findings, sharing the historical significance and the ripple effects of the innovation on later transportation systems and society.

Video Series

Materials Needed: A curated series of educational videos covering the history of transportation, with a focus on the transition from past methods to modern technologies and the reasoning behind these developments. Here are some suggestions:

- **The Invention of the Wheel and Early Transport:** Explore the earliest forms of transportation, focusing on the invention of the wheel and its impact on human mobility.
- **The Age of Sail and Exploration:** Highlight the developments in sailing technologies that enabled global exploration and trade.
- **The Steam Engine and the Industrial Revolution:** Cover the introduction of the steam engine and its revolutionary impact on transportation, including the first railways and steamships.
- **The Birth of the Automobile:** Discuss the invention of the automobile, key figures like Karl Benz and Henry Ford, and the societal changes brought about by mass-produced cars.
- **The Era of Flight:** Trace the history of aviation from the Wright Brothers' first flight to modern commercial airlines and the jet age.
- **Space Exploration:** Introduce the history of space exploration, from the first rockets to the Apollo moon landings and current missions to Mars.
- **Modern Innovations and Sustainable Transport:** Look at contemporary advances in transportation technology, such as electric vehicles, high-speed rail, autonomous cars, and the push towards sustainability.

Procedure:

- **Viewing:** Watch the selected videos as a class, ensuring each segment is followed by a brief pause for note-taking and reflection.
- **Discussion:** After viewing, facilitate a class discussion based on reflective questions related to the videos. Questions might include: "How did societal needs drive transportation innovation?" or "What role does technology play in shaping future transportation systems?"

Evaluation

- **Timelines:** Evaluate the timelines for historical accuracy, creativity in presentation, and the depth of insight shown into the impact of transportation advancements.
- **Reflective Essays/Discussion:** Assess students' reflective essays or contributions to discussions for their understanding of transportation history, critical thinking about the implications of these advancements, and the ability to connect historical trends with present-day transportation challenges.

Lesson 2 aims to enrich students' understanding of transportation's historical context, connecting past innovations with current urban planning and societal needs. By engaging in research, collaborative analysis, and reflective discussions, students will gain a deeper appreciation for the role of transportation technology in shaping human history and modern life.

Lesson 3: Global Transportation Networks

Objective: To provide students with a comprehensive understanding of the operational dynamics of global transportation networks and their pivotal role in supporting international trade, economic development, and global connectivity.

Materials Needed:

Interactive Map Exercises: Access to online mapping tools (e.g., Google Earth, ArcGIS) and resources detailing global transportation networks.

Procedure:

- **Exploration Phase:** Guide students to use online mapping tools to explore and identify key global transportation hubs such as major ports, airports, and logistic centers. Highlight the significance of geographical locations like the Panama Canal, the Suez Canal, and major straits in global shipping routes.
- **Analysis Activity:** Students analyze how these hubs and routes facilitate international trade and connectivity. Encourage them to consider factors like distance, geopolitical stability, and infrastructure quality.
- **Group Presentation:** In small groups, students present their findings, focusing on a particular hub or route and discussing its role in global transportation networks.

Discussion

Focus Points:

- **Economic Impact:** Initiate discussions on how global transportation networks underpin international trade and contribute to economic growth. Incorporate examples of economies heavily reliant on shipping and aviation.
- **Environmental Considerations:** Explore the environmental impacts of global transportation, discussing fuel consumption, emissions, and potential sustainable alternatives.
- **Geopolitical Factors:** Discuss how geopolitics affect global transportation networks, including the impacts of international conflicts, trade wars, and piracy.

Case Study

Materials Needed: Articles, reports, and documentaries detailing recent disruptions in global transportation networks (e.g., the Suez Canal blockage, COVID-19 pandemic's impacts).

Procedure:

- **Case Selection:** Assign different case studies to small groups, focusing on incidents that have disrupted global transportation and supply chains.
- **Analysis and Solution Proposal:** Each group analyzes their assigned disruption, assessing its causes, impacts, and the responses it elicited. They then propose strategies for mitigation and future prevention.
- **Class Discussion:** Groups share their analyses and proposals, facilitating a class-wide discussion on the resilience of global transportation networks and potential improvements.

Evaluation

- **Map Exercise Presentations:** Assess the thoroughness and insight of the presentations based on the groups' ability to identify and explain the significance of global transportation hubs and routes.
- **Discussion Participation:** Evaluate students on their active engagement in discussions, particularly their ability to articulate the complex interplay between global transportation networks and economic, environmental, and geopolitical factors.

- **Case Study Analysis:** Grade groups on the depth of their case study analysis, the feasibility of their proposed mitigation strategies, and the clarity of their presentation.

Lesson 3 aims to extend students' understanding of transportation from a historical and urban planning context to a global perspective, highlighting the importance of international transportation networks in today's interconnected world. Through interactive mapping, discussions, and case studies, students will appreciate the complexities of global trade routes and the challenges facing international transportation systems.

Lesson 4: Technology in Transportation

Objective: Explore the forefront of transportation technology, including electric vehicles, autonomous cars, and smart infrastructure, to understand their development, implications, and the ethical considerations they entail.

Materials Needed

Research and Presentation: Access to research resources such as academic journals, industry reports, and technology news outlets.

Procedure:

- **Technology Selection:** Allow students to choose or assign them a specific emerging transportation technology. Encourage diversity in selections to cover a broad range of innovations.
- **Research Guidelines:** Provide a framework for their research, directing students to explore the technology's development history, operational mechanisms, potential societal and environmental impacts, and any ongoing real-world applications or pilot programs.
- **Class Presentation:** Students present their findings, highlighting the significance of their technology in transforming future transportation landscapes. Encourage the use of visual aids and demonstrations to enhance understanding.

Simulation and Modeling Activity

Materials Needed: Simulation software that can model transportation scenarios (e.g., traffic simulation software) or basic materials for physical models.

Procedure:

- **Simulation Setup:** Introduce students to simulation tools or model-building kits that can represent how new technologies might integrate into existing urban and transportation systems.
- **Challenge Assignment:** Task students with designing a simulation or model that demonstrates the impact of their chosen technology on urban traffic flow, safety, or environmental sustainability.
- **Group Discussion:** After completing their models or simulations, students discuss their observations and insights, focusing on the practical challenges and potential benefits of technology implementation.

Debate

Structure:

- **Debate Preparation:** Divide the class into two groups for each technology, one advocating for its adoption and the other outlining potential drawbacks.
- **Debate Topics:** Include topics such as the environmental impact, ethical considerations of autonomous decision-making, and societal changes due to the widespread adoption of these technologies.
- **Moderation and Evaluation:** Facilitate the debate, ensuring respectful and constructive exchanges. Evaluate students on their argumentation skills, evidence use, and ability to engage with counter-arguments.

Evaluation

- **Presentations:** Assess the depth of research, clarity of presentation, and students' ability to engage their audience. Criteria include comprehensiveness, insightfulness, and communication effectiveness.
- **Simulation and Modeling Activity:** Evaluate the practical understanding of technology applications, creativity in model or simulation design, and the ability to discuss the observed impacts and challenges.
- **Debate Participation:** Grade students on their critical thinking, argumentation skills, and engagement in respectful dialogue. Emphasis should be placed on the use of factual evidence and the ability to consider multiple perspectives.

Lesson 4 weaves the thread of technological advancement into the fabric of transportation education established in earlier lessons. By engaging students in research, practical application through simulation, and critical debates, this lesson aims to foster a nuanced understanding of how emerging technologies could redefine transportation and, by extension, society itself.

Lesson 5: Transportation and Society

Objective: To explore the interplay between transportation systems and societal factors, focusing on issues of accessibility, equity, and the overall impact on communities.

Materials Needed

Survey Project: Digital tools for survey creation (e.g., Google Forms), access to community forums or platforms to distribute the survey.

Procedure:

- **Survey Development:** Guide students to develop a survey that investigates local transportation challenges, with questions designed to uncover issues of accessibility, equity, and community needs.
- **Community Engagement:** Distribute the survey within the community using online platforms, local community centers, or social media, aiming for a broad range of respondents.
- **Data Analysis:** Upon collecting the responses, students analyze the data to identify key transportation challenges faced by different community segments.

Role-Playing Activities

Materials Needed: Scenarios detailing various stakeholder perspectives in transportation planning (available online or created by instructors).

Procedure:

- **Stakeholder Identification:** Assign students roles as different stakeholders in transportation, such as city planners, disabled individuals, environmental advocates, and business owners.
- **Scenario Exploration:** Through role-playing, students explore the impacts of transportation decisions from their assigned stakeholder's perspective, discussing the implications of various transportation projects and policies.

- **Reflection:** Conclude the activity with a debrief, encouraging students to share insights gained from their roles and discuss how different perspectives can influence transportation planning and policy-making.

Community Project Proposal

Materials Needed: Research on local transportation issues, tools for project design (digital or paper-based).

Procedure:

- **Project Ideation:** In groups, students use insights from the survey project and role-playing activities to identify a transportation-related need in their community.
- **Proposal Development:** Each group designs a project proposal aimed at addressing the identified need, considering factors such as practicality, budget, and potential impact.
- **Presentation:** Groups present their proposals to the class, explaining their project's objectives, expected impact, and how it addresses the principles of equity and accessibility.

Evaluation

- **Survey Project:** Assess the comprehensiveness of the survey, the effectiveness of data analysis, and the ability to draw meaningful conclusions from the community feedback.
- **Role-Playing Activities:** Grade students on their engagement with the role-playing exercise, the depth of their perspective-taking, and their contributions to the post-activity reflection.
- **Community Project Proposal:** Evaluate the feasibility, creativity, and depth of consideration for social impacts in the project proposals. Special emphasis should be placed on how proposals address accessibility and equity issues.

Piloting and Feedback

- **Preparation:** Make sure all lesson materials are readily available and provide clear guides for facilitators to ensure smooth activity execution.
- **Implementation:** Foster an environment that encourages student-led discussions and presentations, enriching the learning experience by connecting theoretical knowledge with real-world applications.

- **Feedback & Evaluation:** Regularly collect feedback to gauge lesson engagement and relevance. Use various assessment tools to measure student understanding and refine lessons based on this feedback to maintain their effectiveness and engagement.

Lesson 5 not only synthesizes the educational journey from understanding the technicalities of transportation to appreciating its societal dimensions but also empowers students to become proactive participants in shaping their communities. Through this lesson, students are encouraged to apply their accumulated knowledge in a way that considers the social fabric of their surroundings, thereby concluding the series with a strong emphasis on civic responsibility and community engagement.

Bibliography

- Afterschool Alliance. (2020). *America After 3 PM*.
<https://afterschoolalliance.org/AA3PM/data/geo/National/overview>
- Bates, A.W. (2019). *Teaching in a Digital Age*. 2nd edition. Tony Bates Associates Ltd.
<https://www.tonybates.ca/teaching-in-a-digital-age/>
- Bruner, J. S. (1960). *The Process of Education*. Harvard University Press.
- California Department of Education. (n.d.). *Funding Opportunities*.
<https://www.cde.ca.gov/ls/ex/fundingop.asp>
- Fashola, O. S. (1998). *Review of extended-day and after-school programs and their effectiveness. Report No. 24*. Center for Research on the Education of Students Placed At Risk.
<https://eric.ed.gov/?id=ED424343>
- Garrett, T. (2018). Career readiness and transportation education. *Journal of Career and Technical Education*, 33(1), 45–59.
- Halpern, R. (2003). *Making Play Work: The Promise of After-school Programs for Low-income Children*. Teachers College Press.
- Honey, M. A., & Hilton, M. (2011). *Learning Science Through Computer Games and Simulations*. National Academies Press.
- Litman, T. (2020). Transportation and sustainable development. *International Journal of Sustainability*, 12(2), 34–48.
- Little, P. M. D., Wimer, C., & Weiss, H. B. (2008). After school programs in the 21st century: Their potential and what it takes to achieve it. *Harvard Family Research Project*, 10, 1–12.
<https://archive.globalfrp.org/evaluation/publications-resources/after-school-programs-in-the-21st-century-their-potential-and-what-it-takes-to-achieve-it>
- McKee, H. (2017). Civic responsibility in transportation education. *Journal of Education for Sustainable Development*, 11(1), 28–42.
- National Research Council. (2015). *STEM Integration in K–12 Education: Status, Prospects, and an Agenda for Research*. National Academies Press.
<https://nap.nationalacademies.org/catalog/18612/stem-integration-in-k-12-education-status-prospects-and-an>

- National Academies of Sciences, Engineering, and Medicine. (2018). STEM workforce for the future: By the Committee on STEM Workforce Strategies for the Nation; Board on Science and Technology for Sustainability; Policy and Global Affairs Division. National Academies Press. <https://doi.org/10.17226/25001> [Believe this should be cited as: National Academies of Sciences, Engineering, and Medicine. (2018). *Design, Selection, and Implementation of Instructional Materials for the Next Generation Science Standards: Proceedings of a Workshop*. The National Academies Press. <https://doi.org/10.17226/25001>
- Rodrigue, J. P. (2017). *The Geography of Transport Systems*. Routledge. doi.org/10.4324/9780429346323
- Southeast Transportation Workforce Center. (2019). *National Transportation Career Pathways Report*. SETWC. <https://www.nntw.org/wp-content/uploads/2020/04/NTCPI-Year-Two-Report-final.pdf>
- U.S. Department of Education. (2017). *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*. Office of Educational Technology. <https://tech.ed.gov/files/2017/01/NETP17.pdf>
- Voogt, J., Knezek, G., Cox, M., Knezek, D., & ten Brummelhuis, A. (2013). Under which conditions does ICT have a positive effect on teaching and learning? A Call to Action. *Journal of Computer Assisted Learning*, 29(1), 4–14.
- Wandeler, H., Hart, J., & Mercado, A. (2019). Fresno State Transportation Challenge. *Journal of Transportation Education*.
- Wandeler, H., & Hart, J. (2022). Central Valley Transportation Challenge. *California Transportation Journal*. [These last two citations appear to be missing journal details. Are they published online?]

About the Authors

Christian Wandeler, PhD

Dr. Wandeler is an associate professor in research methods and statistics at the Kremen School of Education and Human Development at California State University, Fresno. He is a faculty fellow at the Fresno State Transportation Institute and has developed active transportation-related learning experiences for K–12. His research interests are the development of hope and learning achievement, project-based learning, and self-managing teams. An example of an active transportation related project can be found here <https://transweb.sjsu.edu/research/2009-Fresno-State-Transportation-Challenge>.

Felipe Mercado, EdD

Imagine education not confined to classrooms, but woven into the fabric of everyday life. This is the vision of Dr. Mercado, a man who tirelessly builds bridges between academic rigor, real-world experience, and heartfelt compassion. As a former elementary principal, Mercado ignited curiosity within young minds, fostering understanding and inclusivity. Now, at California State University, Fresno, his passion extends beyond campus walls. His latest project, a transformative transportation initiative, epitomizes this dedication. It champions sustainable development and community engagement, aligning perfectly with Mercado's belief in education's transformative power. Dr. Mercado's expertise transcends traditional boundaries. Certified in compassion and happiness coaching, he featured in an EMMY Award-winning documentary, tackling complex social issues with sensitivity and insight. His blog, "The Authentic Self," dispenses practical advice on finding personal fulfillment, while his involvement in community organizations reflects his commitment to societal progress.

MTI FOUNDER

Hon. Norman Y. Mineta

MTI BOARD OF TRUSTEES

Founder, Honorable Norman Mineta***
Secretary (ret.),
US Department of Transportation

Chair, Jeff Morales
Managing Principal
InfraStrategies, LLC

Vice Chair, Donna DeMartino
Retired Transportation Executive

Executive Director, Karen Philbrick, PhD*
Mineta Transportation Institute
San José State University

Rashidi Barnes
CEO
Tri Delta Transit

David Castagnetti
Partner
Dentons Global Advisors

Maria Cino
Vice President
America & U.S. Government
Relations Hewlett-Packard Enterprise

Grace Crunican**
Owner
Crunican LLC

John Flaherty
Senior Fellow
Silicon Valley American
Leadership Form

Stephen J. Gardner*
President & CEO
Amtrak

Ian Jefferies*
President & CEO
Association of American Railroads

Diane Woodend Jones
Principal & Chair of Board
Lea + Elliott, Inc.

Priya Kannan, PhD*
Dean
Lucas College and
Graduate School of Business
San José State University

Will Kempton**
Retired Transportation Executive

David S. Kim
Senior Vice President
Principal, National Transportation
Policy and Multimodal Strategy
WSP

Therese McMillan
Retired Executive Director
Metropolitan Transportation
Commission (MTC)

Abbas Mohaddes
CEO
Econolite Group Inc.

Stephen Morrissey
Vice President – Regulatory and
Policy
United Airlines

Toks Omishakin*
Secretary
California State Transportation
Agency (CALSTA)

April Rai
President & CEO
Conference of Minority
Transportation Officials (COMTO)

Greg Regan*
President
Transportation Trades Department,
AFL-CIO

Rodney Slater
Partner
Squire Patton Boggs

Paul Skoutelas*
President & CEO
American Public Transportation
Association (APTA)

Kimberly Slaughter
CEO
Systra USA

Tony Tavares*
Director
California Department of
Transportation (Caltrans)

Jim Tymon*
Executive Director
American Association of
State Highway and Transportation
Officials (AASHTO)

Josue Vaglienty
Senior Program Manager
Orange County Transportation
Authority (OCTA)

* = Ex-Officio
** = Past Chair, Board of Trustees
*** = Deceased

Directors

Karen Philbrick, PhD
Executive Director

Hilary Nixon, PhD
Deputy Executive Director

Asha Weinstein Agrawal, PhD
Education Director
National Transportation Finance
Center Director

Brian Michael Jenkins
National Transportation Security
Center Director

