



Sustainability Perspectives of Graduate Students on Transportation Systems and Management

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Abstract

Graduate students take transportation and systems management course routinely in the college of engineering. They have been taught in the traditional way using the standard lecture format. In this method, sustainability is taught as one of the many constraints by spending approximately one hour of lecture. Both the method of standard lecture and the duration of the lecture are insufficient for equipping the students not only for understanding the concepts of sustainability, but also mastering and committing them for contributing their share for the sustainable environment.

The students were taught in every lecture the appropriate component(s) of sustainability and related ethics. The students were given 4 assignments on these topics. The lectures and the student assignments explored various problems such as global society, business perspectives and people. At the beginning of the course the students were given a pre-intervention survey on their sustainability perspective on transportation systems and management. At the end of the course the same survey was given.

The average grade of the pre-intervention survey was 66% and that of the post-intervention survey was 78%, and 18% improvement over the pre-intervention. The results were significantly different with a calculated t value of 2.9. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05.

Many students wrote excellent comments on several specific problems of transportation systems and management. They were analyzed and graded. Students have shown their personal contribution on keeping the sustainability at present level. They considered innovative and practical concepts such as switching to hybrid vehicles, telework, and combining trips.

Introduction and Literature Review

Understanding of sustainability is essential for the transportation engineering and management students. In President Obama's 2012 State of the Union address, he showed a strong commitment for producing clean energy¹. More specifically, in his 2011 State of the Union address, the President declared that 80% of the energy used in the United States will come from clean energy sources by 2035².

Most trips in almost all of the metropolitan regions in the country are driven by the owners of the cars with ridership ratio of 1:1 (between the number of riders and the cars). This process is not only costly to individuals and society but also leads to air pollution and congestion. There are several solutions to this complex problem. One of the solutions is sharing cars. This is a more efficient, but less convenient method. The objectives of this method are (1) to reduce traffic by reducing the number of cars needed by households and (2) allow commuters to bike, walk, and use transit³.

Specific Objectives

The following are the specific objectives of this paper.

- (1) to enhance graduate students' understanding on the sustainability perspectives of graduate students on a Transportation Systems and Management course.
- (2) to equip the students for providing meaningful local solutions for sustainable problems.

Motivation

The needs of sustainability and the commitment of the US President were the driving forces for authors' motivation for the purpose of the study.

Methodology

Graduate students take transportation and systems management course routinely in the college of engineering. They have been taught in the traditional way using the standard lecture format. In this method, sustainability is taught as one of the many constraints by spending approximately one hour of lecture. Both the method of standard lecture and the duration of the lecture are insufficient for equipping the students not only for understanding the concepts of sustainability, but also mastering and committing them for contributing their share for the sustainable environment.

The course has several modules. They deal with Air and Ground Transportation Systems and Management. At the beginning of the course the students were given a pre-intervention survey on their sustainability perspective on transportation systems and management. At the end of the course the same survey was given. They were not told that the survey would be given again at the end of the semester.

Evaluation of Students understanding of the subject

The students were taught in every lecture the appropriate component(s) of sustainability and related ethics. The students were given 4 assignments on these topics. The first assignment focused on sustainability perspectives applied to global society. In this assignment the students were expected to use a broad holistic approach that incorporated social and societal aspects. The second assignment concentrated on sustainability perspectives applied to business aspects including cost per unit and scale of economies. The third assignment was on user friendliness. The fourth assignment dealt with people's nature, values, aesthetics, and future generations. The 4 assignments were graded consisting 20% of the course grade. The grading formula was given in Table 1.

Each student was asked to write his or her understanding of the subject using two case studies. These case studies consisted 15% of the course grade. The grading of the case studies demonstrated that students understood the subject effectively. The written comments described in a separate section also demonstrate this point.

Problems in the course

Eight problems covering a wide variety of areas in transportation systems and management were identified by the instructor. These included not only technical problems but also social problems. The social problems were global society, people's nature and values, and business perspectives. The technical problems were use of high occupancy vehicles, walking and cycling path improvements, speed reduction and traffic calming techniques, traffic demand management strategies, access (for transportation infrastructure) management programs.

How the problems of the course are addressed?

Several lectures were taught covering open ended solutions for these problems. Students were assigned case studies in developing solutions for these problems. At the beginning of the semester the students were asked to complete pre-intervention survey on these (eight) problems. At the end of the semester students were asked to complete a post-operation survey in ranking these problems (also known as the Performance Indices) on the applicability for achieving the sustainability of transportation systems and management in Philadelphia (Table 2). In both the surveys the students were asked to provide written comments on these problems.

Significance about the pedagogical process

The following is the significance about the pedagogical process described in the article that distinguishes it and makes it interesting for other to note.

In the pre-intervention survey the students could not provide any meaningful solutions as applied to the local region Philadelphia. The pedagogical process emphasizes the importance of equipping the students for providing meaningful local solutions. The students' empowerment distinguishes it and makes it interesting for other to note. The most important part is the students written comments shown in a separate section of the paper. An examination of the students' comments indicates that they learned the subject matter effectively. It is important to note that these solutions are limited to this class consisting of this mix of students only. Future students of this course or students of other courses may see different set of solutions with varying emphasis. Table 3 shows the statistical analysis of Performance Indices^{4,5,6}.

Results and Discussion

The average grade of the pre-intervention survey was 66% and that of the post-intervention survey was 78%, and 18% improvement over the pre-intervention. The results were significantly different with a calculated t value of 2.9. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05.

It is important to note that this study and modification of a single course alone is not going to have a meaningful impact on addressing sustainability. However the efforts of Temple University's Center for Sustainable Communities (CSC) coupled with other courses taught at the university by various faculty (for example, Environmental Sustainability, Environment, Transportation planning, Introduction to Community and Regional Planning) can have

meaningful effect on sustainability. The authors plan to extend this strategy to three other courses over the next two years. The method presented in this study may be used at other institutions with appropriate modifications in order to prepare the students for improving their technological literacy.

The students ranked Walking and Cycling Path Improvements the highest that would lead to sustainable transportation management systems in Philadelphia. Many expressed that this solution would lead to a drastic reduction of cars on the roads causing a ripple effect on the reduction of traffic delays, traffic pollution and improving nation's economy. They ranked business perspectives as the last one. They specifically mentioned that though they ranked it as the last one they felt that it still has significant impact on improving the sustainability of the transportation systems in Philadelphia.

Student comments

The following are the written comments from students.

1. The teacher taught me how to visualize the universe of sustainability as applied to transportation systems and management rather than back me up every time I have a question.
2. I learned how to use creativity while working on Case /studies.
3. The present work would give a future student a launching pad to jump start his/her own work.
4. I love the nontechnical issues such as global perspectives, people's nature and values in transportation.
5. Philadelphia needs walking and cycling path improvements for achieving sustainable transportation. After learning several excellent concepts in my evaluation this single item alone can have the highest impact on improving sustainability. This conclusion is an eye-opening for me.
6. It was one of the most rewarding learning experiences I have ever had as a student. It was a lot of fun working with the students on case studies.
7. I have developed fascinating understanding about the transportation sustainability problems and their solutions in Philadelphia.
8. Two students wrote that the open-ended nature of the course was difficult to cope with.
9. The single most mind broadening learning concept in this course for me is that the existing alternatives to the privately owned automobile were ineffective because they have been introduced one step at a time on an individual improvement basis. Instead, they should have been integrated into the whole transportation system.
10. Almost all the students wrote that they would consider innovative and practical concepts such as switching to hybrid vehicles, telework, and combining trips.

Many students wrote excellent comments on demand management strategies including road pricing, parking management strategies, taxing gasoline (a highly debated topic arguing strongly on both sides), access management including ramp metering, transit improvements and rideshare

programs, and commute trip reduction programs. They were analyzed and graded. Students have shown their personal contribution on keeping the sustainability at present level. They considered innovative and practical concepts such as switching to hybrid vehicles, telework, and combining trips.

How other institutions have addressed the problem?

Many universities deal with sustainability issues with varying emphasis. However, the following universities offer a wide variety of courses in addition to having dedicated centers dealing with sustainability issues. The list of the universities is an example only.

UC Berkeley offers the following courses: Air Pollution, Civil Systems and the Environment, Transportation & Land Use Planning, Design for Sustainable Communities, Transportation Sustainability, and Environmental Engineering Design. The courses offered by Harvard University are Energy and the Environment, Sustainable Cities; Urbanization, Infrastructure, and Finance, and Transportation Planning and Development. University of Illinois at Urbana Champagne offers Sustainable Urban Systems, environment and sustainable Development courses. The courses offered by the University of Texas at Austin are Topics in Sustainable Development, Sustainable Cities, Management Sustainability Practicum, and Engineering Sustainable Technology.

Conclusions

The average grade of the pre-intervention survey was 66% and that of the post-intervention survey was 78% and 18% improvement over the pre-intervention. The t-test confirmed statistical improvement at significant confidence level with an alpha value of 0.05.

The graded case studies and all most all of the written comments of the students on the sustainability and ethical issues on specific problems such as High Occupancy Vehicles, Walking and Cycling Path Improvements, Speed Reductions and Traffic Calming, Traffic Demand Management Strategies, Access Management Programs, Global Society, Business Perspectives, People's Nature and Values were not only positive but also demonstrated their improvement of the knowledge on providing solutions to the problems.

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Table 1 Grading Formula

	Percent
1. Assignments	20
2. Attendance and class participation	10
3. Mid-term examination	25
4. Final Examination	30
5. Case studies	15
Total	100

Table 2 Improvement of the Post-intervention Survey over the Pre-intervention Survey

Performance Index	Pre-intervention Survey (%)	Post-intervention survey (%)	Improvement (%)	Relative Rank
(1) High Occupancy Vehicles	64	77	20	3
(2) Walking and Cycling Path Improvements	65	81	25	1
(3) Speed Reductions and Traffic Calming	68	83	22	2
(4) Traffic Demand Management Strategies	65	77	18	4
(5) Access Management Programs	68	78	15	6
(6) Global Society	66	75	14	7
(7) Business Perspectives	66	74	12	8
(8) People's Nature and Values	67	79	18	5

Table 3 Statistical analysis of Performance Indices

Performance Index	Standard Deviation		t value
	Pre-intervention Survey (%)	Post-intervention survey (%)	
(1) High Occupancy Vehicles	12	13	2.9
(2) Walking and Cycling Path Improvements	14	15	3.6
(3) Speed Reductions and Traffic Calming	10	12	3.4
(4) Traffic Demand Management Strategies	9	16	2.7
(5) Access Management Programs	13	13	3.6
(6) Global Society	11	10	3.5
(7) Business Perspectives	13	14	3.1
(8) People's Nature and Values	15	11	3.2

Reviews

A reviewer commented on the draft

.....What is significant about the pedagogical process described in the article that distinguishes it and makes it interesting for others to note...

Authors' Response

A separate section is added as shown in the paper.

A reviewer commented on the draft

Please elaborate more on how the students understanding of this subject is evaluated and also what specific goals you plan to accomplish.

Authors' Response

A separate sections are added as shown in the paper.