Application of Traffic Simulation and Animation Modules for Transportation Engineering Undergraduate Courses

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Introduction

The practice of transportation engineering has evolved substantially over the past several decades. The task of transportation education in this era is not only to train students in how to do various activities associated with current practice, but also to provide students with the tools necessary to solve new problems that arise.

However, most transportation-related courses are still addressed in a traditional way with “chalk and talk” lectures, “paper and pencil” problem-solving, and class projects or papers on related topics, failing to motivate students and preventing them from effectively assimilating and applying knowledge in their future work. This approach to education does not expose undergraduate students to the myriad of challenging issues that arise in the industry.

Computer simulation and visualization techniques have been suggested as a promising strategy for teaching in a range of studies. Simulation allows learners to engage actively by running experiments, testing different strategies, and building a better understanding of the aspects of the real world which the simulator depicts. Visualization techniques allow students to explore and manipulate computer-generated, 3-dimensional, multimedia environments in real time, and 3D animation is a powerful tool to present complex conditions and procedures in an easy-to-understand format.

Two web-based simulation modules developed by the University of Minnesota, Roadway Online Application for Design (ROAD) and Agent-based Demand and Assignment Model (ADAM), were introduced in the Transportation Engineering course which is a standard part of undergraduate civil engineering programs.

Objectives

- Assist students to understand the concept of geometric design through conducting the geometric design of roadway with the computer software tool ROAD. ROAD allows students to design the geometry of a roadway more efficiently and effectively. Furthermore, students have the option to visualize the final roadway design in a 3D virtual reality environment.
- Help students understand the concept of travel demand in a more intuitive way with the computer software tool ADAM. Students can evaluate the roadway network performance including trip origins and destinations, traffic flow and cost with the software directly. Students can also specify and test their assumption of travelers’ goal and behavioral rules with ADAM, which will greatly enhance students’ understanding of underlying mechanism behind travel demand forecasting.

Methodology

- A student background survey with 17 questions was conducted just before the lab to figure out the students' demographic distribution, learning preference and experience on transportation engineering.
- An evaluation survey with 14 questions was accomplished right after the lab to testify the screen, interface and learning facilitation of the software, and the effectiveness of and overall reaction to the lab.

Data Collection

- 41 students from two classes participated in the labs
- 38 and 39 survey forms were returned for the student background and evaluation survey respectively

Data Analysis

- Figure 1 Computer Software Tool Interface
- Figure 2 Simulation and Animation Results
- Figure 3 Roadway Geometric Design Lab

Computer Proficiency

- Figure 4 Computer Proficiency

Learning Preference

- Figure 5 Learning Preference

Quality as Learning Tool

- Figure 6 Quality as Learning Tool

Learning Experience

- Figure 7 Learning Experience

Conclusion and Recommendation

- With an active experimentation learning preference and wide usage of computer among engineering students, it’s practical to use computer animation and visualization in undergraduate transportation engineering class.
- The effectiveness of computer animation and visualization in engineering education highly depends on the efficiency of the computer software tool and the difficulty of the designed task. Too complicated questions would cause students to become impatient and lose their interest in it.
- To ensure better performance from computer simulation and visualization, the lab should be designed in the simplest way that only limited steps would be required, and the operation should be accomplished with the software in the most straightforward way.

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