

Assessment Plan

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This project focuses on developing an assessment plan for one learning unit in undergraduate engineering education. This plan contains class description, learning unit description, learning objectives and goals, and the three proposed classroom assessment techniques. The objective of this project is to develop a holistic plan that will align objectives, goals, teaching activities, and classroom assessment for improvement of student learning and overall classroom environment.

Class description

The subject class is CEE 4604 - Traffic Engineering, offered every Fall semester by Charles Via Jr. Department of Civil and Environmental Engineering (CEE) at Virginia Tech. This class is a continuation of CEE 3604 - Introduction to Transportation Engineering, offered by the same department. The usual class size is around 40 students, mostly from CEE department, with a few students from Department of Industrial and Systems Engineering. Classes are held two times per week, in the duration of 75 minutes.

Focus of the course is on the design and traffic operations of streets and highways, covering a range of principles and practice. Topics covered include driver characteristics, vehicle characteristics, traffic flow characteristics, data collection and statistical analysis for traffic engineering applications, roadway capacity and level of service analysis, intersection analysis, traffic signal timing design, pavement markings and signing design, Intelligent Transportation Systems applications and wide-area urban traffic management planning. After completion of this course, students are expected to be able to identify operational problems, carry out traffic engineering studies, design and evaluate alternative solutions, thus having the knowledge and skill set for an entry-level position in traffic engineering.

Considering that students take this course as a senior course, before becoming practicing engineers, demonstration of equivalent professionalism and ethics is expected. Beside the official requirement of having the grade of C- or better in CEE 3604, there is an essential prior knowledge base for understanding all the concepts and practice from CEE 4604. This knowledge base includes the basics of vehicle characteristics and dynamics, highway design, capacity analysis, and signalized intersections operation. The course is structured around the book Traffic Engineering: Fourth Edition by Roess, Prassas, and McShane, but also includes chapters from traffic engineering handbooks and manuals, along with youtube videos and short on-line readings. In addition, the class is envisioned to include a discussion blog. The grades are assigned based on class activities, blog discussions, assignments, exams, design project, and verbal exam.

Learning unit description

The learning unit under analysis here is conducted in the weeks five and six of the course. This learning unit consist of the following three lectures:

1. Highway capacity and level of service; deterministic analysis of basic freeway section
2. Deterministic level of service analysis for freeway merge/diverge and weaving sections
3. Simulation analysis of level of service for all types of freeway sections

The lectures are primarily conducted as conventional ex cathedra lecture. However, each lecture will include additional activities specific to the underlining topic. First class will be mainly focused on the Socratic-type discussion for revisiting important concepts of capacity and Level of Service. Second class will be mainly focused on step by step calculation procedure, due to the increased complexity of deterministic analysis of merge/diverge and weaving freeway sections. This lecture will also have a demonstration of Highway Capacity Software. Third class will include several youtube videos and the demonstration of traffic simulation software.

Learning objectives and goals

The objectives of the learning unit are related to the following class-level goals:

- Analyze level of service for freeways and urban intersections using analytical procedures based on Highway Capacity Manual and related software;
- Analyze level of service for freeways and urban intersections using simulation procedures based on traffic simulation software;

From these class goals, unit objectives are defined as:

- Analyze the relations between traffic flow and capacity parameters
- Determine the influencing factors to level of service parameters according to Highway Capacity Manual
- Apply deterministic level of service analysis on the basic, merge/diverge and weaving freeway sections
- Determine level of service for freeway sections using traffic simulation

A general teaching goals inventory developed for this class using an on-line tool (T. A. Angelo & K. P. Cross, 1993) is presented on the following Figure 1.

Cluster	Goals Included in Cluster	Percent Rated "Essential"	Mean Rating
I. Higher Order Thinking Skills	1-8	75%	4.50
II. Basic Academic Success Skills	9-17	0%	2.00
III. Discipline-Specific Knowledge and Skills	18-25	50%	4.25
IV. Liberal Arts and Academic Values	26-35	0%	1.90
V. Work and Career Preparation	36-43	0%	2.13
VI. Personal Development	44-52	11%	2.44

Figure 1: Teaching Goals Inventory (T. Angelo & P. Cross, 1993)

In-depth analysis of these goals focuses on essential and not applicable goals, as two extremes that should improve the understanding of required outcomes of this learning unit. The essential goals are following:

- Develop ability to apply principles and generalizations already learned to new problems and situations
- Develop analytic skills
- Develop problem-solving skills
- Develop ability to draw reasonable inferences from observations
- Develop ability to synthesize and integrate information and ideas
- Develop ability to think holistically: to see the whole as well as the parts
- Learn terms and facts of this subject
- Learn concepts and theories in this subject
- Develop skill in using materials, tools, and/or technology central to this subject
- Learn techniques and methods used to gain new knowledge in this subject
- Develop capacity to think for oneself

On the other hand, non-applicable goals are following:

- Develop aesthetic appreciation
- Develop an informed historical perspective
- Develop an informed understanding of the role of science and technology
- Develop an informed appreciation of other cultures
- Develop capacity to make informed ethical choices
- Develop management skills
- Develop leadership skills
- Develop a commitment to personal achievement
- Develop ability to perform skillfully
- Cultivate emotional health and well-being
- Cultivate physical health and well being

These two lists clarify that this learning unit is mainly focused on higher-order learning skills and discipline-specific knowledge and skills, since it involves analytical procedures and concrete engineering practice. This learning unit is not focusing on liberal arts, academic values, and basic academic success skills.

Classroom Assessment Techniques

Considering the activities and goals of this learning unit, three classroom assessment techniques (CAT) are planned. The two CATs are primarily related to accomplishing the assessment of course-related knowledge and skills, while the third is designed to assess the reactions to teaching and teacher.

CAT 1 – Preconception/misconception check

The first CAT envisioned for this learning unit is preconception/misconception check. This CAT is implemented as a questionnaire, checking the existence of prior knowledge that might present an

obstacle to learning new concepts. Students enrolled in CEE 4604 are expected to have previous knowledge about the concepts related to capacity and level of service analysis. In addition, the concepts of traffic flow theory are revisited and expanded during the week 2 of the course. However, considering the overall goal of this course as a preparation for traffic engineering positions, and the corresponding importance of level of service analysis, it is essential that these concepts are clarified before the actual demonstration of the analysis procedures.

Individual misconception check is planned for anonymous collection at the beginning of the first lecture in this learning unit. After the brief introductory in-class discussion, the students will be asked to dedicate 5 minutes in answering several questions. This CAT is envisioned to collect the information on the preconceptions about traffic flow theory and its relation to capacity and level of service analysis. Specifically, this CAT will collect the information on the preconceptions related to macroscopic traffic parameters, relations between volume, speed, and density, along with the relation of these parameters and freeway capacity.

Two or three misconceptions that are most frequent, along with two or three misconceptions that deviate the most from the actual concepts' relations will be selected for follow up discussion. In addition, the discussion will try to determine the reasoning for the existence of misconceptions. This discussion should help students distinguish facts and firmly define the terms of the subject, prior to learning new concepts of level of service analysis. In addition, in-class discussion after the collected information should also develop the openness to new discoveries in the field of traffic flow theory and level of service analysis.

CAT 2 - Application cards

The second CAT in this learning unit is the application cards. This CAT is envisioned for implementation in the last class of this learning unit. Just as the previous CAT, this too will be implemented to assess course-related knowledge and skills. Application card is usually consisted of one question about the possible application of concepts and procedures learned, and is focusing on determining students level of understanding of the unit material.

This CAT was selected as a final step towards holistic understanding of capacity and level of service analysis for freeways and transfer of these concepts to other transportation facilities. Individual application cards will be collected anonymously towards the end of the last class of the unit. The students will be required to describe a real-world project for the analysis of any road transportation facility with the description of application/examples of level of service analysis. Students will have approximately four minutes to provide their description. From these descriptions, the instructor will select three most descriptive, three most creative, and three completely unacceptable applications. Each of these applications will be discussed for at least two minutes, considering correct concepts, potential improvements, and taking into consideration different analysis approaches.

This CAT will assess students' ability to apply principles learned, generalize and reason new application situations. In addition, this CAT should help students complete their understanding of level of service analysis and two conceptually different approaches for its completion. Finally, students will be greatly encouraged to think creatively and individually.

CAT 3 - Group instructional feedback technique

The third CAT is a group instructional feedback technique and is focused on collecting reactions to teacher and teaching. It consists of collecting anonymous student response on three questions:

- What is helping the learning?
- What is hindering learning?
- What are specific practical suggestions for improving the lecture and learning in the classroom?

This CAT is selected for implementing since this learning unit is approximately at one third of the course duration. At this point in time, students should have enough information to provide feedback on teaching, and there is still significant amount of time for requested improvements of learning environment.

The questions on what works, what does not work, and what can be done for improvement will be collected by a third party person. At the end of the second lecture, the instructor will introduce the person responsible for collecting the feedback. This person will ensure the objectivity of the provided feedback. After a brief discussion on this feedback technique, students will be informed about the time and web link for completing the online questionnaire with aforementioned three questions. Collected comments and suggestions will be summarized, and in the case of conflicting suggestions (e.g., more graphics vs. less graphics), another poll will be performed during the third class. In this poll, students will anonymously vote on the three most important suggestions. All the information will be used to modify the teaching approach or teaching material. In addition, this technique should also help students develop reasonable inferences from observations, and learn to evaluate class methods and materials.

CAT evaluation

Evaluating these suggested CATs before their implementation, the expectations are following:

- First two CATs are expected to be context-sensitive since they provide useful information on what specific group of students is or is not learning/knowing about a specific topic at a given moment in the learning unit. This is especially related to the choice of preconception check for the first lecture, and application cards for the last lecture.
- They are expected to be flexible for adaptation by different instructors, due to their simplicity and importance to the learning of concepts of this unit.
- The combination of these three CATs are expected to make a difference since combined they assess aspects of teacher and student behavior. In addition, they are expected to result in an overall benefit – improved student learning, improved teaching methods, and improved overall classroom atmosphere.
- Selected CATs are expected to be relatively easy to administer, easy to respond to, and easy to get feedback, since they do not contain more than three questions that are usually responded by one or two sentences. With this in mind, along with the information on the class size, all CATs are expected to be relatively easy to administer, and provide feedback.

Reflections

One of the limitations of these CATs is the availability of additional human resources for their implementation. Implementation of preconception check and application cards would require a teaching assistant present in the classroom to improve the efficiency of data collection. Group instructional feedback technique would require availability of another, independent, person that could successfully conduct the discussion and questionnaire. Other concerns are related to the availability of technical resources (e.g., internet service, power sources, etc.) and appropriate announcements for completion of web-based information collection.

During the development of this plan, the author was concerned about the potential improvements in the efficiency of propose CATs in the case these CATs were implemented throughout the curriculum of this and other classes. Consequentially, the validity of the collected information from these assessment techniques might improve or deteriorate, depending on the subjects previous experiences with similar CATs.

References

Angelo, T., & Cross, P. (1993). Teaching Goals Inventory Retrieved 02/21/2012, from http://fm.iowa.uiowa.edu/fmi/xsl/tgi/data_entry.xsl?-db=tgi_data&-lay=Layout01&-view

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