Use of the TRB Research Needs Statements Database in an Introductory Transportation Course

TRB Session 821 – Paper 17-02931
PRESENTATION OUTLINE

- Research Motivation & Objectives
- Methods
- Empirical Results
- Conclusions
- Future Directions
Projects are an integral part of undergraduate engineering education.

Topic selection imposes a great challenge for college students.

But, limited research exists on the subject.

The internet has drastically changed higher education.

One’s ability to conduct an exhaustive search diminishes due to the superabundance of information.
Are there any web tools that can help students identify a topic that is of interest to them that is also worth pursuing in terms of research and practice?

Research Needs Statements (RNS) Database

An important function of the Transportation Research Board (TRB) is to stimulate research that addresses concerns, issues, or problems facing the transportation community. In support of this function, TRB Technical Activities standing committees identify, develop, and disseminate research need statements (RNS) for use by practitioners, researchers, and others. The RNS on this website have been developed by the technical committees.

Search
- To retrieve a record or records in the database, enter a word or phrase in the "Search Term" box.
- For a wild-card search, use an asterisk (*) after a partial word.
- For a boolean search, use OR, AND, or AND NOT between words or phrases.
- For the committee field, click "Lookup" to search based on your entered text.

Search Phrase [search_box] [Search]
RESEARCH OBJECTIVES

Investigate:

✓ How students can use the TRB RNS database as a tool to identify areas of research to pursue
  • as part of an introductory engineering course focusing on transportation systems.

✓ Whether the RNS database is beneficial for use in coursework
  • specifically as part of a term design project.
METHODS

Overview

Data were collected in the:

- Spring 2016 offering of:
  
  \textit{CE361-Introduction to Transportation Engineering}
  
  - An elective undergraduate-level course
  - Offered every semester
  - Purdue University

- Students used the RNS database for the term design project.
## METHODS

### Class Composition

<table>
<thead>
<tr>
<th>Engineering Major</th>
<th>Students</th>
<th>Educational Level</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil</td>
<td>42</td>
<td>Freshman: 0 - 14 hrs</td>
<td>1</td>
</tr>
<tr>
<td>Construction</td>
<td>3</td>
<td>Junior 1: 60 - 74 hrs</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical</td>
<td>2</td>
<td>Junior 2: 75 - 89 hrs</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior 1: 90 - 104 hrs</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Senior 2: 105+ hrs</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>47</td>
</tr>
</tbody>
</table>
METHODS

Term Project Description

- Students could undertake:
  - any type of site-specific study, case study, design project, or planning-related project
  - with a focus on any transportation-related problem of their choice.

- Learning goal of the term project:
  - Provide students with the opportunity to work towards solving real-world problems.
  - Foster critical thinking.
  - Provide students with a more comprehensive perspective of the topics covered during the semester.
METHODS

Term Project Description

Subm. 1—Proposal: Instructor-assigned groups of ~10

Subm. 2—Outline: Student-selected groups of 1-5

Subm. 3—Report: Student-selected groups of 1-5

5% of grade

Project was divided into tasks

1-5 group members were assigned to each task based on:

- the difficulty and workload of each task
- students’ interests and background

10% of grade
Methods

Data Collection-General

- Primary data collection instrument: survey distributed during the last week of classes.
  - Students were given credit as part of the quizzes/in-class activities grade for completing the survey
  - Completed online
  - Was not anonymous

- The students’ educational level was used to identify patterns in the responses.

- Students’ work and scores on the three project submissions were also collected and linked to their responses.
METHODS

Data Collection-Survey

The survey instrument included:

- 2 questions on actual usage:
  1. Did you personally use the database?
  2. Did you read the needs statement selected?

- 6 questions soliciting info on students’ perceptions of:
  - the ease of use,
  - usefulness, and
  - experience with the database and selection of their statement

- 5 open-ended questions asking students to:
  - provide feedback on a number of relevant topics, and
  - justify their responses to the six questions mentioned above.
Two-step analysis:

1. **Descriptive statistics** of the quantitative data collected from the survey were explored.

2. The feedback provided by the students through the **open-ended questions** was **summarized and reviewed for patterns**.

- Sample size was not large enough to perform statistical tests for significance.

- A thematic qualitative analysis is used.
## EMPIRICAL RESULTS

**Survey Responses: Closed-Ended Questions**

<table>
<thead>
<tr>
<th></th>
<th>Freshman</th>
<th>Junior 1</th>
<th>Junior 2</th>
<th>Senior 1</th>
<th>Senior 2</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I found the TRB RNS database easy to use and understandable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td></td>
<td>14</td>
<td>24 (73%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2 (6%)</td>
</tr>
<tr>
<td>No opinion</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3 (9%)</td>
</tr>
<tr>
<td>I found the TRB RNS database useful for this project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (6%)</td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>5 (15%)</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>11</td>
<td>22 (67%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3 (9%)</td>
</tr>
<tr>
<td>No Opinion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1 (3%)</td>
</tr>
</tbody>
</table>

Responses of Students Who Searched Through the RNS Database (n = 33)
## EMPIRICAL RESULTS

Survey Responses: Closed-Ended Questions

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Junior 1</th>
<th>Junior 2</th>
<th>Senior 1</th>
<th>Senior 2</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Searching through the TRB RNS database helped me identify and select a topic of interest for the project</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>12%</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>No Opinion</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>

**Responses of Students Who Searched Through the RNS Database (n = 33)**

- Strongly Disagree: 3%
- Disagree: 6%
- Agree: 9%
- Strongly Agree: 12%
- No Opinion: 70%
## EMPIRICAL RESULTS

### Survey Responses: Closed-Ended Questions

<table>
<thead>
<tr>
<th></th>
<th>Freshman</th>
<th>Junior 1</th>
<th>Junior 2</th>
<th>Senior 1</th>
<th>Senior 2</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Using the TRB RNS database helped me jumpstart my project</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td>3</td>
<td>7 (16%)</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>11</td>
<td>23 (52%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (5%)</td>
</tr>
<tr>
<td>No opinion</td>
<td>3</td>
<td>2</td>
<td></td>
<td>5</td>
<td></td>
<td>10 (23%)</td>
</tr>
<tr>
<td><strong>Using the TRB RNS database helped me find a topic that is relevant to current transportation research and practice</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>10</td>
<td>27 (61%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>4 (14%)</td>
</tr>
<tr>
<td>No Opinion</td>
<td>1</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td>7 (16%)</td>
</tr>
</tbody>
</table>

*Responses of All Students (n = 44)*
### EMPIRICAL RESULTS

**Survey Responses: Closed-Ended Questions**

<table>
<thead>
<tr>
<th></th>
<th>Freshman</th>
<th>Junior 1</th>
<th>Junior 2</th>
<th>Senior 1</th>
<th>Senior 2</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would recommend using the TRB RNS database for similar projects in the future</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3 (7%)</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>15</td>
<td>30 (68%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3 (7%)</td>
</tr>
<tr>
<td>No Opinion</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>5 (11%)</td>
</tr>
</tbody>
</table>

**Responses of All Students (n = 44)**

- **Strongly Disagree**: 11%
- **Disagree**: 7%
- **Agree**: 68%
- **Strongly Agree**: 7%
- **No Opinion**: 7%
EMPIRICAL RESULTS
Survey Responses: Open-Ended Questions

- Perceived Ease of Use:
  - The search function was easy to use,
  - The use of keywords was helpful, and
  - The titles of the RNS were useful.

“...easy to search using keywords or areas of interest to find related research needs statements.”

“The search function was very easy to use.”

“The needs statements had detailed titles that allowed us to quickly search for topics of interest.”
EMPIRICAL RESULTS
Survey Responses: Open-Ended Questions

- Perceived Ease of Use:
  - Well-organized and easy to use web interface.
  - The categorization of the RNS by subjects is useful.
  - The search directions were well-perceived.

- "Clean website user interface that was easy to navigate."
- "User friendly"
- "It has clear classifications and easy to find information."
- "It gave guidance with suggestions on how to find a suitable needs statements."
EMPIRICAL RESULTS
Survey Responses: Open-Ended Questions

- **Perceived Difficulty of Use:**
  - Some students felt that the search function and display of the resulting RNS from a search could be improved.
  - The search function is sensitive to word choice.
  - A preview function where the search results are displayed would be helpful.

  "The search feature was not great, as typing similar but slightly different words or phrases did not produce similar results."

  "[One] had to click on [the] link to view [the statement]. A description on [the] search window could be helpful."
EMPIRICAL RESULTS

Survey Responses: Open-Ended Questions

- Perceived Difficulty of Use:
  - Some students felt overwhelmed by the amount of information included.
  - The inconsistent quality of the RNS was a concern.
  - The students’ knowledge of the terminology was a concern.

“Sometimes there were too much information”

“Technical language, some pre-search needed to understand it all.”

“...some of the statements were pretty old and some were not well-done or only consisted of small amounts of words with few to no literature links or references.”
EMPIRICAL RESULTS

Survey Responses: Open-Ended Questions

- Perceived Usefulness:
  - Provided a good base for formulating the problem statement.
  - Were helpful as a tool to generate ideas.
  - Helped the students narrow down the project scope to a specific topic.

  "It gave us the basis of our paper"

  "It helped us find a need to base our problem statement off of."

  "It helped us focus on [a] specific idea"

  "It helped to spark the idea of what aspects ... should be looked at."

  "It helped us focus on [a] specific idea"
EMPIRICAL RESULTS
Survey Responses: Open-Ended Questions

- Perceived Usefulness:
  - Provided information to help students start researching their topic.
  - Provided information to guide work on a specific topic.
  - Helped with identifying relevant topics.

“It gave us a good starting point and general understanding of what we were researching.”

“We were able to focus on the relevant problems at hand and work towards them.”

“It gave us the general direction on the statement.”
EMPIRICAL RESULTS

Survey Responses: Open-Ended Questions

- Perceived Usefulness:
  - Provided an idea of the research that has been done already on a topic.
  - Useful introduction to terminology specific to a topic.
  - Students had a better understanding of the topic after reading the RNS.

“It gave us good groundwork as to what research was likely being done already.”

“We were able to use the names and vocabulary from the RNS to tailor out problem statement.”

“We understood the problems and difficulties in the topic we chose, which helped us form a problem statement.”
Students perceived the RNS database to be a useful tool for the class purposes.

A few challenges faced by the students in their efforts to utilize this tool were identified.

Most students recommended the future use of the database for similar class projects.
- This suggests a preference over other traditional topic identification and selection methods.

Future use of the database for similar introductory classes and perhaps other graduate-level classes is recommended.
Recommendations for Future Use of the RNS Database

- Introduce and demonstrate the use of the database to the students during a class session.
- Alternatively, introduce as part of a homework to familiarize students with it and its functions.
- Provide students with guidance/specific suggestions on how to use the database in the context of the project.
- The purpose of using the database and the ways the database can be useful should be explained in detailed.
CONCLUSIONS

Considerations for TRB

There are a few things that would potentially enable broader use for educational purposes:

- A thorough review to ensure the quality of the statement.
- Flag statements that might be suitable for use in university courses or research (such as for theses and dissertations).
- Students provided a number of additional recommendations:
  - Include an easier *bookmark* option on the site,
  - Ensure that the *categorization* of the statements is appropriate,
  - Make *more* statements available,
  - Provide a more flexible and natural *search function*, and
  - Flag topics as “*popular*.”
FUTURE DIRECTIONS

Study Limitations and Future Directions

- Relatively small course in which a term project was the impetus for using the database.
- Sample size was not sufficient to perform statistical analyses.
- The specifics of the design of the term project and its implementation, the student demographics, and the course setting limit the generalizability of the findings.
- Additional implementation studies.
- The survey instrument should be reviewed and revised.
- Other study designs can provide further insights into the broader benefits of using this tool.
Similar but refined study setup.
- Addition of a HW that will introduce the database.
- Survey after both the HW and the project completion.

Additional research questions:
- Students at different institutions use the database differently.
- The use of the database enhances experiential learning associated with the project.
- The use of the database improves the identification and formulation of relevant Civil Engineering problems.
- The use of the database increases the students’ awareness of contemporary transportation-related topics.

Revised Questionnaires.
QUESTIONS
and/or
COMMENTS?

