Exploring Relationships between Students’ Discussion Patterns, Emotions, and Learning Outcomes in an Online Mathematics Course

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Introduction

Background of the study

Online Discussions

- Widely used in higher education settings
- Promote individual and group knowledge construction
- Do not always lead to productive interactions and knowledge construction
- Prior studies have focused on students’ posting behaviors, rather than online speaking & listening behaviors

Students’ Emotions

- Directly or indirectly influence their learning outcomes
- Especially in developmental mathematics courses, students’ negative emotions and anxiety play a significant and negative role in performance
Introduction
Research Purpose and Research Questions

RQ1
What online **discussion behaviors** and **emotions** characterize different groups of students? How do these relate to student learning outcomes?

RQ2
How does the **content of online discussions** vary within different groups of students? How do these relate to student learning outcomes?

Diagram:
- **Canvas LMS**
  - Clickstream data
  - Textual data (Content of online discussions)
- Online discussion behaviors
- Students’ emotions
- Identifying subgroups of students
- Learning outcomes
  - online developmental math course
- Data Pre-processing
  - Text mining
  - Classification and Regression Tree (CART)
  - Co-occurrence network analysis
A framework for examining engagement in online discussions (Wise et al., 2013; 2014)

- **Online Speaking**
  - Externalizing one’s ideas by posting

- **Online Listening**
  - Taking in the externalizations of others (i.e., students’ attend to others’ posts)

- **Quantity**
  - Volume of discussion

- **Breadth**
  - Distribution throughout the discussion

- **Intensity**
  - Multiple contributions to a specific thread
Methods
Research context and participants

Canvas LMS used at a university located in the western U.S.
Online developmental math (statistics) course offered during Summer 2015
77 undergraduate students

Online Discussions
- 11 discussion board threads
- Participation points were awarded for posting messages (3% of final grades)
- No required minimum # of postings
- 387 new messages & 430 replies (a total of 15,176 words)

Example of the discussion prompt

Module 6 Discussion
Ask and answer questions about Module 6 here. Here’s a great article about probability.....
Methods

Measure 1: Discussion behaviors

- **Online Speaking**
  - **Quantity**
    - Total # of new messages made
    - Average message length (in words)
  - **Breadth**
    - Percent of threads with a minimum of one message

- **Online Listening**
  - **Quantity**
    - Total # of replies made
    - Total # of views of (any) discussion threads
  - **Breadth**
    - Percent of threads read at least once
## Methods

### Measure 2: Students’ emotions


<table>
<thead>
<tr>
<th>Positive emotions</th>
<th>Negative emotions</th>
<th>Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of positive emotion words within a message</td>
<td>% of negative emotion words within a message</td>
<td>% of words related to anxiety within a message</td>
</tr>
<tr>
<td>e.g.) love, nice, thank</td>
<td>e.g.) hurt, ugly, nervous</td>
<td>e.g.) worried, fearful</td>
</tr>
</tbody>
</table>

- **Example**
  
  Thanks for your help!

  - LIWC analysis results for positive emotions = \( \frac{1 \text{ positive word ("thanks")}}{4 \text{ words}} \times 100 \) = 25.00
  
  for negative emotions = 0.00.
## Methods

### Data analysis

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Data mining techniques</th>
<th>Tools</th>
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<tbody>
<tr>
<td><strong>RQ1.</strong> What <em>online discussion behaviors and emotions</em> characterize different</td>
<td><strong>Text mining</strong></td>
<td>LIWC</td>
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<td>groups of students? How do these relate to student</td>
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<td><a href="http://liwc.wpengine.com">http://liwc.wpengine.com</a></td>
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<td><strong>Classification and Regression Tree (CART)</strong></td>
<td>R studio</td>
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<td>• non-parametric decision tree method</td>
<td><a href="http://khc.sourceforge.net">http://khc.sourceforge.net</a></td>
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<tr>
<td><strong>RQ2.</strong> How does the <em>content of online discussions</em> vary within different groups</td>
<td><strong>Co-occurrence network analysis</strong></td>
<td></td>
</tr>
<tr>
<td>of students? How do these relate to student learning outcomes?</td>
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</table>
Results

RQ 1. Online discussion behaviors, emotions and learning outcomes

- Results of the CART analysis predicting student final scores
Percent of discussion threads read?

- 50% of threads or above
- Less than 50% of threads
  - n= 70

Total number of replies made?

- 0.5 replies or above
- Less than 0.5 replies
  - n= 63

Expressing negative emotions?

- Less than 2.5% of negative words
- 2.5% of negative words or above
  - n= 49

Average message length

- 103 words or above
- Less than 103 words
  - n= 42

Total number of replies made?

- 4.5 replies or above
- Less than 4.5 replies

Group 1 (n = 7)
- M = 54.54
- (SD = 28.87)

Group 2 (n = 7)
- M = 66.71
- (SD = 20.53)

Group 3 (n = 14)
- M = 76.64
- (SD = 14.68)

Group 4 (n = 7)
- M = 77.03
- (SD = 14.21)

Group 5 (n = 16)
- M = 85.60
- (SD = 13.02)

Group 6 (n = 26)
- M = 92.45
- (SD = 4.55)

Low average final scores

High average final scores
Results

RQ 2. The content of online discussions and learning outcomes

- Co-occurrence diagram for group 1

Group 1: Low participators

- The **lowest average final scores** ($M = 55$, $SD = 28.87$)
  - Sparse content network
  - **Content not relate to course topics**

- Size of the nodes: Frequency of the words
- Color: Centrality in terms of social network analysis
  (light blue to white to pink in ascending order of centrality value)
Results

RQ 2. The content of online discussions and learning outcomes

- Co-occurrence diagram for group 3

Group 3: Negative Viewers (n = 14)

- Average final scores ($M = 76.64$, $SD = 14.68$)
- The highest average level of negative emotions, anxiety, and the # of views
- Used the discussion boards to express concerns or to ask questions
**Results**

RQ 2. The content of online discussions and learning outcomes

- Co-occurrence diagram for group 6

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**Group 6: Consistent Participators (n = 26)**

- The **highest average final scores**
  
  \( M = 92.45, \ SD = 4.55 \)

- Showed a higher level of online listening behaviors

- Talked about specific course content
Conclusion

Discussion Behaviors
- The most important variable in terms of predicting students’ learning outcomes were related to students’ online listening behaviors

Students’ Emotions
- Results showed that negative emotions (but not positive or anxious) also played an important role.

Discussion Content
- The lower performing subgroups did not appear to talk about course content.
- The highest performing subgroup, however, discussed specific course topics.
Key Citations


Thank you

Questions / Comments?

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