KNOWLEDGE DISCOVERY OF STUDENT SENTIMENTS IN MOOCS AND THEIR IMPACT ON COURSE PERFORMANCE

Conrad S. Tucker, Engineering Design and Industrial Engineering
Bryan Dickens, Computer Science and Engineering
Anna Divinsky, School of Visual Arts, World Campus

{ctucker4, bid5098, axd289}@psu.edu
PRESENTATION OVERVIEW

- Background
- Motivation
- Methodology
  - Mining MOOC data
  - Performance Correlation
- Case Study
- Results
- Conclusions
- Future Work
In-class student engagement is readily observable...
Students experience positive mental states while minimizing those mental states associated with negative connotations.

### Emotional State | Learning Gains Impact | References
--- | --- | ---
Engagement/Interest | Positive | [21, 7]
Frustration | Negative | [25, 9]
Boredom | Negative | [26]
Confusion | Positive | [9, 25, 27]
Delight | Positive | [9]
Hypothesis: Students’ emotional states (quantified through textual data) are correlated with their performance on assignments.

- towards individually customized learning
The Challenge in Massively Open Online Courses (MOOCS)

Research Motivation

Tucker, Dickens, Divinsky 2014
Educational Data Mining

Educational Systems
(“Brick and mortar”, MOOCs, laboratories, etc.)

Data Mining Algorithms
(classification, clustering, etc.)

Mostow et al. (2005), Vialardi et al. (2009), García-Saiz et al. (2014)

Educators
Students

data

knowledge
Research Objectives

• Quantify students’ sentiments in MOOCs by mining student-generated textual data

• Determine whether students’ sentiments correlate with course performance
Research Methodology

Forums

Individual posts

Methodology
Sentiment Scoring Algorithm

\[ Sentiment(post_i) = \sum_{n=1}^{k} map\_lookup(post[n]) \]

procedure map_lookup( ArrayList<String> post )
1    Sentence Sentiment Score = 0;
2    Clean Sentences (post);
3    while post not empty
4       String temporary word = post.remove(post.size() – 1);
5       if (temporary word abbreviated)
6          Substitute full word for temporary word;
7       if( word is emoticon)
6          Sentence Sentiment Score += emoticon sentiment;
7       if( word is in general word list)
6          Sentence Sentiment Score += word sentiment;
7    end
7    return Sentence Sentiment Score;
end map_lookup.
<table>
<thead>
<tr>
<th>Post Text</th>
<th>Sentiment of Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hello everyone!! im from Cyprus! i was born with this talent and i cant</td>
<td></td>
</tr>
<tr>
<td>stop drawing on walls,papers or whatever i can from an early age! :)</td>
<td></td>
</tr>
<tr>
<td>im so enthusiastic about art and expressing our selfs! Good luck everyone</td>
<td></td>
</tr>
<tr>
<td>and i hope this new beggining of ours comes to a success!! Have a great</td>
<td></td>
</tr>
<tr>
<td>week!!!! :))</td>
<td></td>
</tr>
<tr>
<td>i will confess that nothing I create for this class I will consider art.</td>
<td></td>
</tr>
<tr>
<td>I will consider it studies.</td>
<td></td>
</tr>
</tbody>
</table>
## CORRELATION WITH PERFORMANCE

<table>
<thead>
<tr>
<th>$r$</th>
<th>Type of relationship</th>
<th>Color Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>± [0.0 to 0.2]</td>
<td>Weak or no relationship</td>
<td></td>
</tr>
<tr>
<td>± [0.2 to 0.4]</td>
<td>Weak relationship</td>
<td></td>
</tr>
<tr>
<td>± [0.4 to 0.6]</td>
<td>Moderate relationship</td>
<td></td>
</tr>
<tr>
<td>± [0.6 to 0.8]</td>
<td>Strong relationship</td>
<td></td>
</tr>
<tr>
<td>± [0.8 to 1.0]</td>
<td>Very strong relationship</td>
<td></td>
</tr>
</tbody>
</table>

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

$n$: Sample size  
$X_i$: Value of $i$th observation from sample $X$, $i$: 1 to $n$  
$\bar{X}$: Average value of all observations from sample $X$  
$Y_i$: Value of $i$th observation from sample $Y$, $i$: 1 to $n$  
$\bar{Y}$: Average value of all observations from sample $Y$
CASE STUDY
Introduction to Art: Concepts and Techniques

• Penn State MOOC
• was offered through Coursera: Spring of 2013.
• modeled after an online art course “Art 10: Introduction to Visual Studies” taught by Anna Divinsky.
Introduction to Art: Concepts and Techniques

Case Study

Tucker, Dickens, Divinsky 2014

Not enrolled

57.1%

Homeschooling

2.1%

Graduate-
Masters/Ph.D.

13.4%

Undergrad-
BA/BS

16%

Technical/Academic-
High School

17.6%
Results

Distribution of Student Post Frequency

# Posts vs. Student ID

- Post + Comment Count

Tucker, Dickens, Divinsky 2014
Results

Most Frequent Student Poster

Sentiment Score vs Time (Epoch Computer Time)
Results

Average Student Poster

Sentiment Score vs Time (Epoch Computer Time)

post text_Sentiment
Results

$r = -0.016$
Results

$r = 0.04$
## FEEDBACK TO EDUCATORS

<table>
<thead>
<tr>
<th>Task</th>
<th>Approach</th>
</tr>
</thead>
</table>
| Grouping Students             | • Clustering/Classification  
                                | • Social network analysis with visualization                              |
| Detecting Undesirable         | • Outlier Detections                                                      |
| Student Behaviors             |                                                                          |
| Predicting Student Performance | • Feature selection  
                                | • Classification/Clustering  
                                | • Network Mining                                                           |
## FEEDBACK TO STUDENTS

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| Recommending courses to Students | • Relationship mining  
                        | • Classification/Clustering               |
| Encouraging participation online | • Text mining  
                        | • Relationship mining                   |
Conclusion and Path Forward

- MOOCs as “Design Critique” Platforms
- Expand to other MOOCs
- Ground truth data, based on students’ surveys
- Data beyond textual (e.g., image, geospatial, etc.)
Acknowledgement & References

Contributors:
Conrad Tucker (Pennsylvania State University, University Park)
Bryan Dickens (The Pennsylvania State University),
Anna Divinsky (The Pennsylvania State University)

References
• Jia, L., & Wang, R. (2010, October). The application skills of body language in teaching. In Artificial Intelligence and Education (ICAIE), 2010 International Conference on (pp. 18-21). IEEE.