The Relationship Between Social and Emotional Skills and Student Behaviors in Predicting Course-Level Student Success

John Whitmer, Sweet San Pedro, Ruitao Liu, Kate E. Walton, Joann L. Moore, & Alejandro Andrade Lotero

Background

Educational technologies, such as learning management systems (LMS), online homework portals, and ePortfolios, are becoming an increasingly important part of student learning experiences. Data collected by these systems provide valuable insights into student learning practices, and learning analytics (LA) researchers have demonstrated that these data can be used to make accurate predictive models of student course grades (Macfayden & Dawson, 2010). However, the psychological constructs that underlie student online behaviors are not well understood. Similarly, the field of social and emotional learning recognizes that social and emotional (SE) skills are associated with academic performance (Poropat, 2009), but the field is somewhat limited in its understanding of the mechanisms by which certain SE skills lead to academic success.

Objective

In this study, we marry the fields of LA and social and emotional learning to determine whether we can observe SE skills from behaviors recorded in online learning environments, whether high-level learning tactics can be extracted using sequential data mining techniques, whether predictions using LMS behavioral data are more accurate than those based on demographic data, whether and how online behaviors are associated with SE skills and course grades, and whether there is demographic bias in the predictive models.

Method

We evaluated these questions in an undergraduate course making extensive use of the Blackboard LMS. LMS data were available for 489 students in this course, and 406 of them also completed the college version of ACT® Tessera®, an assessment of five SE skills, including Grit, Teamwork, Resilience, Curiosity, and Leadership. For brevity, we present findings for Grit, as well as course grade.

LMS events, such as accessing the syllabus or taking practice exams, were provided at the individual student-activity level for all interactions with course materials and activities that were recorded in the database. Blackboard extracted this information from the hosted version of the LMS with a total of approximately 700,000 records included in the dataset. To discover meaningful learning behavior patterns, we grouped activity sessions into clusters using a hidden Markov modeling technique.

Key Findings

- Some SE skills were systematically observed in student use of the LMS (Figure 1)
- High-level learning tactics could be extracted from activity data using sequential data mining techniques
- Predictions using LMS behavioral data were more accurate than those made using student family and educational background (Figure 2), providing an accurate and powerful basis for actionable interventions
- LMS behavioral data partially mediated the relationship between Grit and course grades
- No evidence of demographic bias was found in predictions
Figure 1. Correlations Between Individual LMS Behaviors and Course Grades and Grit

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number of Attempts on Discussion Board</th>
<th>Time spent on Discussion Board</th>
<th>Variability of time spent on Discussion Board</th>
<th>Number of Sessions</th>
<th>Time spent on Lecture Class Activities</th>
<th>Variability of time spent on Lecture Class Activities</th>
<th>Time spent on Announcements</th>
<th>Variability of time spent on Announcements</th>
<th>Time spent on Gradebook</th>
<th>Variability of time spent on Gradebook</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.177</td>
<td>0.185</td>
<td>0.191</td>
<td>0.206</td>
<td>0.221</td>
<td>0.243</td>
<td>0.307</td>
<td>0.313</td>
<td>0.316</td>
<td>0.358</td>
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Figure 2. Comparative Predictive Model Accuracy for Course Grades and Grit

<table>
<thead>
<tr>
<th>Grade</th>
<th>Baseline</th>
<th>Tessera</th>
<th>Learning Tactics</th>
<th>LMS Activities</th>
<th>Tessera + Learning Tactics</th>
<th>Learning Tactics + LMS Activities</th>
<th>Tessera + LMS Activities</th>
<th>Learning Tactics + LMS Activities</th>
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</thead>
<tbody>
<tr>
<td>Cross-Validated RMSE</td>
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<td>0.899</td>
<td>0.813</td>
<td>0.703</td>
<td>0.768</td>
<td>0.683</td>
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</table>

<table>
<thead>
<tr>
<th>Grit</th>
<th>Baseline</th>
<th>Learning Tactics</th>
<th>LMS Activities</th>
<th>Learning Tactics + LMS Activities</th>
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</thead>
<tbody>
<tr>
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<td>0.899</td>
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</tbody>
</table>

Note: RMSE = root mean squared error

Implications

This research demonstrates that SE skills can be made visible through LMS data and LA techniques. The differences in correlations and model accuracy metrics between these skills and student grades demonstrate that these are unique constructs that can provide students, instructors, and other stakeholders with useful information that they can use to improve student success.

References
