The Smarter Classroom Project
Exploiting Human Signals in Learning Environment as an Alternative to Evaluate Education Performance

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Aims and Objectives

- Classify individual and group behaviour based on human signals in learning environments.
- Correlate social behaviour to education performance.
- Recommend actions to improve the education performance, as for example adjust the Digital Education Content, personalisation, and others.
The “Smarter Classroom” project

(1) Front-end Solutions

- Teacher
- Video Camera
- Student
- Transcription

(2) Content Processing Methods

- Content Management System
- Video Camera

Other data repositories: e.g. Grades, Student Profiles, etc

(3) Social Learning Analytics

- Repository of Classroom human signals
- Repository of Quality Education Content
- Analytics Models

Objective: understand the relation between individual and social behaviour and education performance

Capture Students’ Events whilst interacting with Education Material

Performance Groups: A, B, C, D

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How does it work?

(1) Manipulation of Education content generates “signals”

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Student 1

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Student 2

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</table>

Student 3

(2) Analytic models analyse data and generate reports

Other data repositories: e.g. Grades, Student Profiles, etc

Analytics Models

Examples

- Level of activity per student
- Level of activity in group
- Level of attentiveness per student
- Level of attentiveness in group
- Performance resolving tasks
- Classification of student behaviour
- Classification of group behaviour
## Example of Analytic Models Created in this Project

<table>
<thead>
<tr>
<th>Analytics Model</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Calculate level of activity while resolving a task</strong></td>
<td>Given a task to read elements and respond to tests ( I \subseteq M ); there is a function ( \text{levAct}(S(c,M)) ) that calculates the level of activity ( \text{acc} ) whilst resolving the task; for instance, a calculation of time between groups of events; there is a function ( \text{avgAct}(C) \rightarrow \alpha ) that calculates the average level of activity of the students in ( C ). The function ( \text{act}(c, I) ) classifies level of activity as: slow activity if ( \text{acc} \leq \alpha*(1-Tac) ), normal activity if ( \alpha*(1+Tac) &gt; \text{acc} &gt; \alpha*(1-Tac) ), and high activity if ( \text{acc} \geq \alpha*(1+Tac) ), where ( Tac ) is a threshold (e.g. ( Tac = 0.2 ) in our experiments).</td>
</tr>
<tr>
<td><strong>Calculate level of attention while resolving a task</strong></td>
<td>Given a task to read elements and respond to tests ( I \subseteq M ); there is a function ( \text{levAtt}(S(c,M)) ) that calculates the level of attention ( \text{atc} ) whilst resolving the task; for instance, it takes in consideration the time between actions, time switching in and out the application (i.e. distractions by other applications), and others; there is a function ( \text{avgAtt}(C) \rightarrow \beta ) that calculates the average level of attention of the students in ( C ). The function ( \text{att}(c, I) ) classifies level of activity as: inattentive if ( \text{atc} \leq \beta*(1-Tat) ), attentive if ( \beta*(1 + Tat) &gt; \text{atc} &gt; \beta*(1-Tat) ), and highly attentive if ( \text{atc} \geq \beta*(1+Tat) ), where ( Tat ) is a threshold (e.g. ( Tat = 0.5 ) in our experiments).</td>
</tr>
<tr>
<td><strong>Calculate performance resolving a task</strong></td>
<td>Given a task to read elements and respond to tests ( I \subseteq M ); there is a set ( E(M,I) = {e_1, ..., e_n} ) of optimal sequence of events to execute the instruction; there is a function ( \text{distOpt}(S(c,M), E(I)) ) that calculates the inverse of the distance ( pfc ) between the sequence executed by the student and what would be the optimal sequence; there is a function ( \text{avgDist}(C) \rightarrow \delta ) that calculates the average performance of the students in ( C ). The function ( \text{perf}(c, I) ) classifies performance as: low performance if ( \text{pfc} \leq \delta*(1-Tpf) ), normal performance if ( \delta*(1+Tpf) &gt; \text{pfc} &gt; \delta*(1-Tpf) ), and high performance if ( \text{pfc} \geq \delta*(1+Tpf) ), where ( Tpf ) is a threshold (e.g. ( Tpf = 0.2 ) in our experiments).</td>
</tr>
</tbody>
</table>
Test Case
Implemented in controlled environment to detect ADHD during vocational training

(1) Students in Vocational Training Using Digital Education Material capturing “human signals”

(2) Analytic models analyse data and generate reports

- Level of activity per student
- Level of attentiveness per student
- Classification of student performance
  - realizing tasks
  - responding exams

Table 1. Example of Test Results

<table>
<thead>
<tr>
<th></th>
<th>Low Activity</th>
<th>Normal Activity</th>
<th>High Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inattentive</td>
<td>Task Low / Exam Low</td>
<td>Task Medium / Exam Low</td>
<td>Task Low / Exam Low</td>
</tr>
<tr>
<td>Attentive</td>
<td>Task Medium / Exam Medium</td>
<td>Task Medium / Exam Medium</td>
<td>Task Medium / Exam Medium</td>
</tr>
<tr>
<td>Highly Attentive</td>
<td>Task High / Exam High</td>
<td>Task High / Exam High</td>
<td>Task High / Exam High</td>
</tr>
</tbody>
</table>

(*) Contain “signals” during manipulation of Education Material
Conclusions

- Advances the state-of-the-art by introducing a method to analyse education performance based on patterns in human signals.
- Able to Classify individual and group behaviour based on human signals in learning environments.
- Able to correlate social behaviour to education performance.
- Successfully experimented in a controlled environment and executed statistic analysis over collected data allowing us to identify categories of student behaviour
  - Tests demonstrate the feasibility and potential of the technology.

Future work:
- Larger test environment: plan for class of 25 students, 3 courses, total of 12 hours class time.
- Experiments with adjustment and personalisation of Education Content.
- New models of self-adjustment of Education Content based on near real-time analysis of signals during manipulation and expected/estimated education performance.
Acknowledgement

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Platform for the Development of Accessible Vocational Training