An Approach for Dynamic Student Modelling of Learning Styles

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Why modelling students’ learning styles?

• Benefits of knowing students’ learning styles:
  – Make students aware of their learning styles
  – Make teachers aware of their students’ learning styles
  – Basis for providing adaptivity based on learning styles
Types of Student Modelling

• Collaborative vs. Automatic
  – Collaborative: asking students directly for feedback
  – Automatic: inferring students’ characteristics from their behaviour and actions

• Static vs. Dynamic
  – Static: once from a particular amount of data
  – Dynamic: frequently updating the student model based on new data
Aim of Research

• Recent research deals with automatic & static student modelling of learning styles (e.g., Cha et al. 2006, Garcia et al. 2007, Graf et al. 2008)

• Focus of this paper is on automatic & dynamic student modelling of learning styles

• Concept is based on the Felder-Silverman learning styles model but can also be applied for other learning style models with similar structure after few revisions
Concept for Dynamic Student Modelling

- We assume that certain amount of data is available (in the beginning very few) and that data are frequently added.
- A main issue is to frequently check whether the new information about students’ behaviour hints for revising the information stored in the student model.
- Two objectives:
  - The currently stored learning style should reflect the current learning style of students as good as possible → updating as soon as a revision can be done.
  - Considering deviations of students’ behaviour and having as less as possible revisions which are then taken back shortly afterwards.
More graphically …
Concept for Dynamic Student Modelling

• Step 1: Learning styles (data points $d_t$) have to be calculated based on students’ behaviour in the course at particular points of time $t$

• Step 2: In order to consider deviations in students’ behaviour, the calculation of the current learning style is based on the means of the last $A$ data points. However, one single data point should not have enough influence to force a revision
Concept for Dynamic Student Modelling

- Step 3: Make decision on whether the currently stored learning style should be revised
  - Difference between stored learning style and average learning style from current and past data
  - Difference between currently identified learning style (d_t) and previously identified learning style (d_{t-1})
  - Compare difference between previously identified learning style (d_{t-1}) and stored learning style as well as the difference between currently identified learning styles (d_t) and stored learning style

\[
\text{If } \left| L_s - \frac{\sum_{i=t-A+1}^{t} d_i}{A} \right| \geq x \text{ AND } |d_t - d_{t-1}| < 2x \text{ AND NOT } \left[ |d_{t-1} - L_s| - |d_t - L_s| > \frac{x}{2} \right] \text{ THEN } L_s = \frac{\sum_{i=t-A+1}^{t} d_i}{A}
\]
Verification of the Approach

• Using data from 75 students from a course about object oriented modelling at a university in Austria

• 1. Experiment: What is the best parameter setting?

<table>
<thead>
<tr>
<th>Accepted difference between calculated and stored learning styles (x)</th>
<th>Amount of data points included in the calculation process of learning styles (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/22</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>0.521</td>
</tr>
<tr>
<td>1/11</td>
<td>0.640</td>
</tr>
<tr>
<td>2/11</td>
<td>0.615</td>
</tr>
</tbody>
</table>
2. Experiment: Verification of composition of the formula for deciding whether a revision is necessary (Are all three conditions necessary?)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>only first condition</td>
<td>0.646</td>
</tr>
<tr>
<td>first two conditions</td>
<td>0.642</td>
</tr>
<tr>
<td>all three conditions</td>
<td>0.656</td>
</tr>
</tbody>
</table>

$x=1/11$, $A=3$
Conclusions and Future Work

- Developed a concept for automatic & dynamic student modelling of learning styles that revises the learning styles stored in the student model frequently.
- Revisions are necessary, when learning styles change and if dynamic student modelling is used for improving and fine-tuning the information in the student model.
- Verified the concept with data from a course with 75 students.
- Future work:
  - Implementing the concept in an adaptive learning system.