Adaptivity in Learning Management Systems focusing on Learning Styles

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Why shall we provide adaptivity in technology enhanced learning?

- Learners have different needs and characteristics
- Adaptivity increases the learning progress, leads to better performance, and makes learning easier

Learning Styles (Felder-Silverman)
- Active/Reflective
- Sensing/Intuitive
- Visual/Verbal
- Sequential/Global
### Comparison of Adaptive Systems and Learning Management Systems

<table>
<thead>
<tr>
<th>Adaptive Systems</th>
<th>Learning Management Systems</th>
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<tr>
<td>+ provide adaptivity</td>
<td>+ are commonly and successfully used</td>
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<tr>
<td>- lack in supporting teachers needs</td>
<td>+ support teachers in creating and managing online courses</td>
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<tr>
<td>- not so commonly used</td>
<td>- Provide only little or, in most cases, no adaptivity</td>
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Research Issues

- How to incorporate learning styles in LMS?
  - How to identify learning styles?
  - How to improve the detection process of learning styles by the use of additional sources?
  - How to provide adaptivity based on learning styles in LMS?

- General aims
  - Developing a concept for LMS in general
  - Implementing and evaluating the concept by the use of a prototype (Moodle)
  - Teachers should have as little as possible additional effort

LMS = Learning Management System
How to identify learning styles?

■ By questionnaires
  ● Motivate students to fill it out
  ● Non-intentional influences
  ● Can be done only once

■ By looking at the students behaviour and actions
  ● Advantages
    ○ Can be done automatically → no additional effort for students
    ○ Can be updated frequently → higher fault-tolerance
  ● Problem/Challenge:
    ○ Get enough reliable information to build a robust student model
How to identify learning styles based on the behaviour of learners?

- **Preceding study:**
  Do students with different learning styles really behave differently in LMS?

- **Main Study**
  - Determining relevant patterns of behaviour
  - Building a model for inferring learning styles from the behaviour
    - Data-driven approach
    - Literature-based approach
  - Evaluation
    - 75 participants
    - Compared the difference between results from the questionnaire, the data-driven approach, and the literature-based approach
Results

- Correctly detected learning styles:

<table>
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<tr>
<th></th>
<th>act/ref</th>
<th>sen/int</th>
<th>vis/ver</th>
<th>seq/glo</th>
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<tbody>
<tr>
<td>data-driven</td>
<td>62.50%</td>
<td>65.00%</td>
<td>68.75%</td>
<td>66.25%</td>
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<tr>
<td>literature-based</td>
<td>79.33%</td>
<td>77.33%</td>
<td>76.67%</td>
<td>73.33%</td>
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- Literature-based approach → suitable instrument for identifying learning styles

- Developed a stand-alone tool for identifying learning styles in LMS applying on the literature-based approach
Improving the detection of learning styles by using information from cognitive traits

- Investigated the relationship between learning styles and cognitive traits (working memory capacity) in order to get more information.
- Comprehensive literature review
  - Indirect relationships between learning styles and WMC
- Exploratory Study with 39 students
  - Promising results (correlations were found)
- Main Study with 225 students
  - Relationship were discovered between WMC and active/reflective, sensing/intuitive and visual/verbal dimension

WMC = Working Memory Capacity
How to provide adaptive courses in LMS?

- Aimed at developing a concept which enables LMS to automatically generate adaptive courses
- Incorporates only common types of learning objects
  - Content
  - Outlines
  - Conclusions
  - Examples
  - Self-assessment tests
  - Exercises
- Adaptation Features
  - Number and position of types of learning objects
Evaluation of the Concept

- 437 participants
- Randomly assigned to 3 groups:
  - Courses that fit to the students’ learning styles (matched group)
  - Courses that do not fit to the students’ learning styles (mismatched group)
  - Standard course which includes all learning objects (standard group)

- Procedure
  - Students filled out a learning style questionnaire
  - Adaptive course is automatically generated and presented
  - Students were nevertheless able to access all learning objects and take a different learning path
Results

- Matched Group: **less time (32%) and equal grades**

- Mismatched Group: **ask more often for additional learning objects**

→ Demonstrates positive effect of adaptivity
Conclusion

- Adaptivity is an important issue for supporting learners

- Extending LMS by combining the advantages of LMS and adaptive systems leads to a more supportive learning environment for learners
Selected Publications

Refereed Journal Publications


Book Chapters


Refereed Conference Publications