Providing Adaptive Courses in Learning Management Systems with Respect to Learning Styles

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Why shall we consider learning styles in LMS?

- Learning Management Systems (LMS) are commonly used in e-education but they provide the same course for all learners.

- Learners have different needs.

- According to literature, adaptivity has potential to facilitate learning.
Adaptivity regarding learning styles

- Two different approaches to provide adaptivity
  - Provide courses that fit to the preferred learning styles
    - Aims at short term goal:
      Makes learning easier and increases the progress
  - Provides courses that do not fit to the learners’ preferred styles
    - Aims at long term goal:
      challenging learners and encouraging them to train learning according to their weak preferences provides them with important life skills
Adaptive Systems

- Adaptive systems aim at providing adaptivity
  - AHA!
  - TANGOW
  - INSPIRE
  - ...

- Limitations
  - are either developed for specific content (e.g. accounting) or for specific features (e.g. adaptive quizzes)
  - content cannot be reused
  - are not often used
Learning Management Systems (e.g., Moodle, Blackboard, WebCT, ...) are developed to support authors/teachers to create courses

- provide a lot of different features
- domain-independent
- content can be reused in other LMS
- are often used in e-education
- provide only little or in most cases no adaptivity
How to provide adaptivity with respect to learning style in LMS?

- Develop a concept that enables LMS to automatically generate course that fit to the students’ learning styles
- Implement the concept as an add-on to Moodle
- Evaluate the concept by a study with 473 students

General aims:
- Combine the advantages of LMS with the ones from adaptive systems through enriching LMS with adaptivity
- Provide a concept for LMS in general
- Teachers should have as little as possible additional effort
Felder-Silverman Learning Style Model (1/2)

- Each learner has a preference on each of the dimensions

**Dimensions:**

- **Active – Reflective**
  - learning by doing – learning by thinking things through
  - group work – work alone

- **Sensing – Intuitive**
  - concrete material – abstract material
  - more practical – more innovative and creative
  - patient / not patient with details
  - standard procedures – challenges

- **Visual – Verbal**
  - learning from pictures – learning from words

- **Sequential – Global**
  - learn in linear steps – learn in large leaps
  - good in using partial knowledge – need „big picture“
  - serial – holistic
Felder-Silverman Learning Style Model (2/2)

- Scales of the dimensions:

  - active
  - reflective

<table>
<thead>
<tr>
<th>+11</th>
<th>+9</th>
<th>+7</th>
<th>+5</th>
<th>+3</th>
<th>+1</th>
<th>-1</th>
<th>-3</th>
<th>-5</th>
<th>-7</th>
<th>-9</th>
<th>-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong preference</td>
<td>Moderate preference</td>
<td>Well balanced</td>
<td>Moderate preference</td>
<td>Strong preference</td>
<td></td>
<td></td>
<td></td>
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</tbody>
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→ Strong preference but no support → problems

- Differences to other learning style models:
  - describes learning style in more detail
  - represents also balanced preferences
  - describes tendencies
How to provide adaptivity?

- Develop a concept which enables LMS to automatically generate adaptive courses
- Incorporates only common kinds of learning objects
  - Content
  - Outlines
  - Conclusions
  - Examples
  - Self-assessment tests
  - Exercises
- Requirements for teachers
  - Provide learning objects
  - Annotate learning objects (distinguish between the objects)
Structure of a course

Chapter 1:

Examples
Self-assessment
Exercises
Outline
Content with/without outlines between subchapters
Conclusion
Examples
Self-assessment
Exercises
Conclusion

Chapter 2:

...
Adaptation features

- Number of examples
- Number of exercises
- Sequence of examples (before or after content)
- Sequence of exercises (before or after content)
- Sequence of self-assessments (before or after content)
- Sequence of outlines (only once before content or between content)
- Sequence of conclusion (after content or at the end of the chapter)
Adaptations for active/reflective learners

- **Active learners**
  - Self-assessments before and after content
  - High number of exercises
  - Low number of examples
  - Outline only at the begin of content
  - Conclusions at the end of the chapter

- **Reflective learners**
  - Outlines between content
  - Conclusion after content
  - Avoid self-assessments before content
  - Examples after content
  - Exercises after content
  - Low number of exercises
Adaptations for sensing/intuitive learners

- **Sensing learners**
  - High number of examples
  - Examples before content
  - Self-assessment after content
  - High number of exercises
  - Exercises after content

- **Intuitive learners**
  - Self-assessment before content
  - Exercises before content
  - Low number of exercises
  - Low number of examples
  - Examples after content
  - Outlines only at the begin of content
Adaptations for sequential/global learners

- **Sequential learners**
  - Outlines only at the begin of content
  - Examples after content
  - Self-assessment after content
  - Exercises after content

- **Global learners**
  - Outlines between content
  - Conclusion after content
  - High number of examples
  - Avoid self-assessment before content
  - Avoid examples before content
  - Avoid exercises before content
General Concept for Providing Adaptivity in LMS
Adaptation Module

- Table which gives information about how the adaptation features can support each learning style preference
  - +1 ... supports the learning style
  - 0 ... does not have an effect on the learning style
  - -1 ... should be avoided in order to support the learning style

- Values are weighted with the strength of the learning style preference
  - 2 ... strong preference (values between +11 to +9 or -11 to -9)
  - 1 ... moderate preference (values between +7 to +5 or -7 to -5)
  - 0 ... balanced preference (values between +3 to -3)
Adaptation Module

- Values of all learning style preferences are summed up
- Results show how the adaptation feature should be applied for each learner
- Advantage
  - Adaptive courses are constructed based on adaptation features
  - New adaptation features can be added easily
  - Considering ambiguous preferences
Ambiguous Learning Preferences

- Active/Reflective = +11 → strong active style
- Sensing/Intuitive = -11 → strong intuitive style
- Sequential/Global = -5 → moderate global style

Number of Exercises
- Active → high number (+1*2=2)
- Intuitive → low number (-1*2=-2)
- Global → no preference (0*1=0)

→ Sum = 0

→ Moderate number of exercises
Evaluation of the Concept

- University course about object oriented modelling with 437 students

Procedure:
- Students filled out the ILS questionnaire
- Individual course was automatically generated according to their learning styles
- Moodle presented the adapted course (as recommendation) to each student
- Students were nevertheless able to access all learning objects and take a different learning path
Evaluation of the Concept

Does adaptivity have an effect on learning?

- Research design
  - Three 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)
Evaluation of the Concept – Statistical Method

- **Requirements for data**
  - Students have to take more than 5 minutes to fill out the ILS questionnaire
  - Students need to submit at least 3 assignments (which was a requirement for a positive mark)

- **Applied group comparison (t-test and U-test)** in order to find significant differences between the groups
Evaluation of the Concept

Results:
- Average score on assignments & score on final exam
  - no significant difference
- Time spent on learning activities
  - Standard (5h 34 min) > Matched (3h 47min)
  - Mismatched (5h 33min) > Matched (3h 47min)
- Number of logins
  - Standard (32 logins) > Matched (28 logins)
- Number of visited learning activities
  - no significant difference
- Number of requests for additional LOs
  - Mismatched (36 requests) > Matched (24 requests)

→ Students from the matched group spent significant less time in the course but achieved in average equal grades
→ Demonstrates positive effect of adaptivity
Conclusion & Future Work

- Developed, implemented, and evaluated a concept for enabling LMS to automatically generate adaptive courses that fit to the learning style of students.
- Enhancing LMS with adaptivity allows teachers to continue holding their courses in LMS and provide students with adaptivity.
- The conducted study shows that our add-on helped students to learn more effectively and therefore facilitates learning.
- Future work deals with a more generic adaptation mechanism, allowing teachers to add also other types of learning objects.
Questions

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