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# Enabling Learning Management Systems to Identify Learning Styles


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# Motivation

- Learning Management Systems (LMS) are commonly used but they provide only little and in the most cases no adaptivity
- Learners have different needs
- Incorporating these needs increase the learning progress, leads to better performance, and makes learning easier
- Requirement for adaptivity: needs have to be known first
  - Comprehensive questionnaires
  - Identification from the behavior of students during a course

# Research Question

## How to enable LMS to identify learning styles?

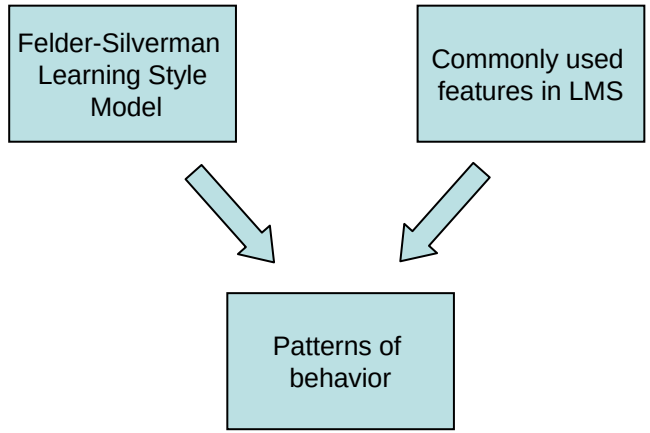
- Developed an approach that identifies learning styles according to the behavior of students in LMS
  - → Identified patterns of behavior
  - → Implemented a tool that
    - extracts data from LMS database and
    - calculates the learning styles
- Which requirements are necessary to provide all recommended information?
- Practical example (Moodle)

# Felder-Silverman Learning Style Model

- Richard M. Felder and Linda K. Silverman, 1988
- Each learner has a preference on each of the four dimensions
- Dimensions:
  - Active – Reflective
    learning by doing – learning by thinking things through
    learning by discussing & group work – work alone
  - Sensing – Intuitive
    concrete material – abstract material
    more practical – more innovative and creative
    patient and careful/not patient and careful 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“
    interested in details – interested in the overview

# Patterns of Behavior

- Felder and Silverman describe how learners with specific preferences act in learning situations
- Mapped the behavior to LMS
- Approach for identifying learning style should be applicable for LMS in general
- Only commonly used features are considered:
  - Content objects
  - Examples
  - Tests (self-assessment and marked)
  - Exercises
  - Communication tools (forum, chat)



# Patterns of Behavior

- Content objects
  - Time student spent on content objects
  - Time student spent on content objects including graphics
  - Number of visits on outlines
  - Time spent on outlines
- Examples
  - Number of visits
  - Time spent on examples
- Tests (self-assessment and marked tests)
  - Results
  - Number of revisions before submission
  - Time spent on the test
- Self-assessment tests
  - Number of tests performed
  - Results on specific kinds of questions (facts/concepts, detail/overview, graphics/text)

# Patterns of Behavior

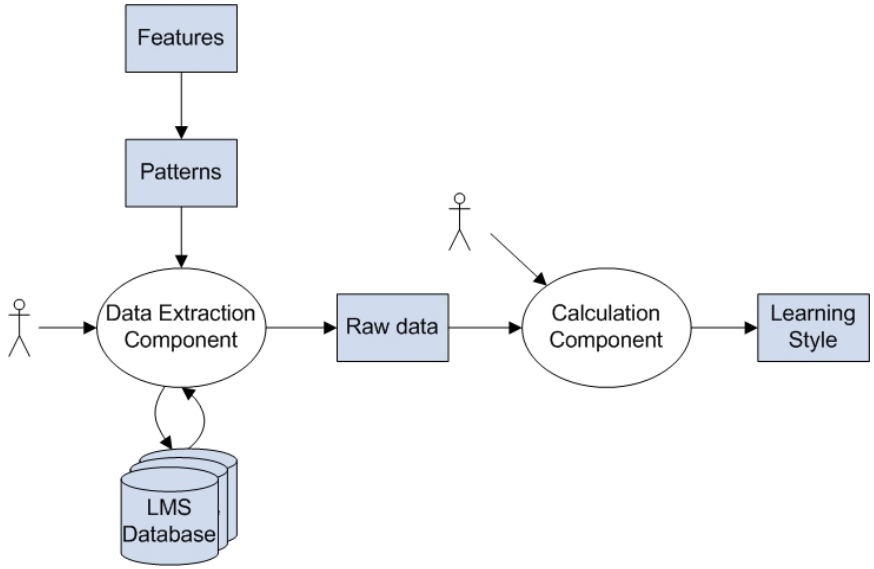
- Exercises
  - Number of visits
  - Time students spent on exercises
- Communication tools: forum, chat
  - Number of visits
  - Number of postings
- Navigation
  - Number of times, students skip learning objects
  - Number of visits of the course content page
  - Time students spent on the course overview page

# Patterns of Behavior

| Active/Reflective | Sensing/Intuitive | Visual/Verbal | Sequential/Global |
|---|---|---|---|
| Visits_forum (act) | Correct_facts/concepts (sen) | Visits_forum (ver) | Correct_detail/overview (seq) |
| Postings_forum (act) | Revisions_marked tests (sen) | Postings_forum (ver) | Performance_marked tests (seq) |
| Visits_chat (act) | Revisions_SA tests (sen) | Visits_chat (ver) | Performance_SA tests (seq) |
| Postings_chat (act) | Duration_marked tests (sen) | Postings_chat (ver) | Visits_outline (glo) |
| Visits_exercise (act) | Duration_SA tests (sen) | Time_graphics (vis) | Time_outline (glo) |
| Time_exercises (act) | Visits_exercises (int) | Correct_graphics (vis) | Skips_learning objects (glo) |
| Time_examples (ref) | Time_exercises (int) | | Visits_overview page (glo) |
| Time_content objects (ref) | Visits_SA tests (sen) | | Time_overview page (glo) |
| | Visits_examples (sen) | | |
| | Time_examples (sen) | | |

# Tool Architecture

- Tool can be applied for LMS in general
  - Each LMS has a different database schema
  - Maybe not all features are used or data for patterns can be tracked
- Architecture:



Requirements for providing all recommended information in LMS:

1. Features have to be available in LMS

2. Behavior have to be tracked by the LMS

3. Authors have to include the respective features in their courses

# Extensions regarding incorporating all features

- Moodle incorporates many features, only some are of particular interest:
  - Resources
  - Quiz
  - Forum
  - Chat
- Learning material regarding all proposed features can be created
- But learning material also has to be distinguished regarding all proposed features

→ Additional meta-data

# Extensions regarding incorporating all features

Resources:

- Resources can be used to present content object, an outline of a chapter or an example
- Performed modifications:
  - Meta-data for distinguishing between content object, outline, and examples
  - Meta-data about whether graphics are included in content objects

# Extensions regarding incorporating all features

Quiz:

- Quizzes can represent self-assessment tests, marked tests, and exercises
- Performed modifications:
  - Meta-data for distinguishing between self-assessment test, marked test, and exercise
  - Meta-data for specifying each question (facts/concepts, details/overview, graphics/text)

No extensions regarding forum and chat

# Extensions regarding tracking activities

- Moodle provides comprehensive tracking functions
- For each action a learner performs, an entry is done in a log table (including user-id, action, time, ...)
- Only one extension is necessary:
  - Revision of answers to self-assessment or marked tests
    - Store each answer
    - Sequence of keys for textual answers (attention to delete and backspace key)

    → Information about how often students are revising their answers

# Conclusion and Future Work

- Proposed an approach that enables LMS to identify learning styles based on the behaviour of students
  → students do not have to fill out comprehensive questionnaires
- Presented a tool that extracts relevant data from the database of the LMS and calculates leanring styles
- Showed how Moodle can be extended to deliver all recommended data (use the tool more effectively)

# Conclusion and Future Work

- Extended version of Moodle has been used for teaching XML at university
- Second course about object-oriented modelling will be held next semester
- Future work will deal with analysing the gathered data and comparing the results from the tool with the results from ILS
- Future work will deal with incorporating partial information in the calculation process