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Adaptivity in Learning Management Systems focussing on Learning Styles

- Supervisors:
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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

Adaptive Systems

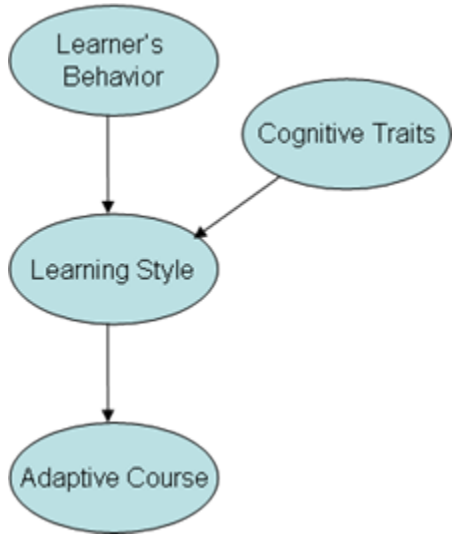
+ provide adaptivity
- lack in supporting teachers needs
- not so commonly used

Learning Management Systems

+ are commonly and successfully used
+ support teachers in creating and managing online courses
- Provide only little or, in most cases, no adaptivity

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:

	act/ref	sen/int	vis/ver	seq/glo
data-driven	62.50%	65.00%	68.75%	66.25%
literature-based	**79.33%**	**77.33%**	**76.67%**	**73.33%**

- 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

- Sabine Graf, Taiyu Lin, and Kinshuk (accepted). **The relationship between learning styles and cognitive traits - Getting addtional information for improving student modelling**. International Journal on Computers in Human Behavior.
- Sabine Graf, Silvia R. Viola, Kinshuk, and Tommaso Leo (2007). **In-depth Analysis of the Felder-Silverman Learning Style Dimensions**. Journal of Research on Technology in Education, Vol. 40, No. 1, pp. 79-93.
- Dunwei Wen, Sabine Graf, Chung Hsien Lan, Terry Anderson, Kinshuk, Ken Dickson (2007). **Supporting Web-based Learning through Adaptive Assessment**. FormaMente Journal, Vol. 2, No. 1-2, pp. 45-79.
- Silvia R. Viola, Sabine Graf, Kinshuk, and Tommaso Leo (2007). **Investigating Relationships within the Index of Learning Styles: A Data-Driven Approach**. International Journal of Interactive Technology and Smart Education, Vol. 4, No. 1, pp. 7-18.

Book Chapters

- Sabine Graf and Kinshuk (accepted). **Learner Modelling Through Analyzing Cognitive Skills and Learning Styles**. In H. H. Adelsberger, Kinshuk, J. M. Pawlowski, D. Sampson, International Handbook on Information Technologies for Learning, Education and Training (2nd edition), Springer.
- Sabine Graf and Kinshuk (accepted). **Analysing the Behaviour of Students in Learning Management Systems with respect to Learning Styles**. In M. Wallace, M. Angelides, P. Mylonas, Springer Series on Studies in Computational Intelligence.
- Sabine Graf and Kinshuk (accepted). **Technologies linking learning, cognition and instruction**. In J. M. Spector, M. D. Merrill, J. J. G. van Merriënboer, & M. P. Driscoll, Handbook of Research on Educational Communications and Technology (3rd edition).

Refereed Conference Publications

- Sabine Graf, Taiyu Lin, and Kinshuk (2007). **Analysing the Relationship between Learning Styles and Cognitive Traits**, Proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT 2007), Niigata, Japan, July 2007, pp. 235-239. (received Best Full Paper Award)
- Sabine Graf and Kinshuk (2007). **Providing Adaptive Courses in Learning Management Systems with Respect to Learning Styles**, *Proceedings of the World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (eLearn 2007)*, Quebec City, Canada, October 2007.
- Sabine Graf, Silvia Rita Viola, Kinshuk (2007). **Automatic Student Modelling for Detecting Learning Style Preferences in Learning Management Systems**. Proceedings of the IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2007), Algarve, Portugal, December 2007.
- Sabine Graf and Kinshuk (2006). **An Approach for Detecting Learning Styles in Learning Management Systems**. Proceedings of the IEEE International Conference on Advances Learning Technologies (ICALT 06), Kerkrade, Netherlands, July 2006, pp. 161-163