

Correlations between Students' Behaviour in Learning Management Systems and their Learning Style Preferences

Sabine Graf
National Central University
Taiwan
sabine.graf@ieee.org

Tzu-Chien Liu
National Central University
Taiwan
ltc@cc.ncu.edu.tw

Kinshuk
Athabasca University
Canada
kinshuk@ieee.org



Motivation

- Many research works have been conducted with respect to learning styles in technology enhanced learning, e.g.,
 - Recommending how systems can adapt to learning styles
 - Building adaptive systems
 - Automatic student modelling
- Most of these research works are based on the learning style model's description about how students with specific learning styles typically behave
- But most learning style models are developed for traditional learning rather than online learning



Aim of Research

How does students behave in an online course considering their learning styles?



→ Correlations between behaviour and learning style preferences

- Learning Management Systems:
 - Support teachers in creating, administrating, and managing online courses
 - Consider a broad range of features of technology enhanced learning (TEL)
 - Are commonly used in TEL
 - By incorporating only behaviour which is common in TEL, we aim at making our results applicable for TEL in general



Benefits from more detailed information

- Student Modelling
 - Automatic approach has several advantages over using learning style questionnaires
 - free of problems regarding inaccurate self-conception
 - Considering data from a time span → more accurate
 - Consideration of changes of learning styles
 - More detailed information about how students really behave in an online environment can make the automatic student modelling approach more accurate
- Adaptive Course Generation
 - More detailed information about how students really prefer to behave can help in developing more precise adaptation features
- Potential of adaptivity regarding learning styles
 - The existence of correlations between behaviour and learning styles gives another indication for the potential of adaptive learning with respect to learning styles



Learning Style Preferences

- Felder-Silverman Learning Style Model (FSLSM)
- 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
interested in details – interested in the overview
good in using partial knowledge – good in connecting areas



Learning Style Preferences

- Index of Learning Styles (ILS)
Questionnaire:
 - Developed by Felder and Soloman
 - 44 questions
 - Result: a value between +11 and -11 for each dimension
- Differences to other learning style models:
 - combine major learning style models
 - describes learning style in more detail
 - represents also balanced preferences
 - describes tendencies



Learning Style Preferences

- Characteristic Preferences within Felder-Silverman Learning Style dimensions (Graf, Viola, Kinshuk, and Leo, 2007)

active

reflective

Student 1	Trying things out	Collaborate with others	Reflect about the material	Work alone
Student 2	Trying things out	Collaborate with others	Reflect about the material	Work alone
Student 3	Trying things out	Collaborate with others	Reflect about the material	Work alone



Learning Style Preferences

- Derived Semantic Groups from the learning style model (Graf, Viola, Kinshuk, Leo, 2007)
- Verifying Semantic Groups by Fisher Linear Discriminant Analysis and empirical frequencies analysis

Style	Semantic group	ILS questions (answer a)	Style	Semantic group	ILS questions (answer b)
Active	trying something out	1, 17, 25, 29	Reflective	think about material	1, 5, 17, 25, 29
	social oriented	5, 9, 13, 21, 33, 37, 41		impersonal oriented	9, 13, 21, 33, 41, 37
Sensing	existing ways	2, 30, 34	Intuitive	new ways	2, 14, 22, 26, 30, 34
	concrete material	6, 10, 14, 18, 26, 38		abstract material	6, 10, 18, 38
	careful with details	22, 42		not careful with details	42
Visual	pictures	3, 7, 11, 15, 19, 23, 27, 31,	Verbal	spoken words	3, 7, 15, 19, 27, 35
		35, 39, 43		written words	3, 7, 11, 23, 31, 39
Sequential	detail oriented	4, 28, 40		Global	overall picture
	sequential progress	20, 24, 32, 36, 44	non-sequential progress		24, 32
	from parts to the whole	8, 12, 16	relations/connections		20, 36, 44

→ Allows building a more accurate model of the student



Design of the Study

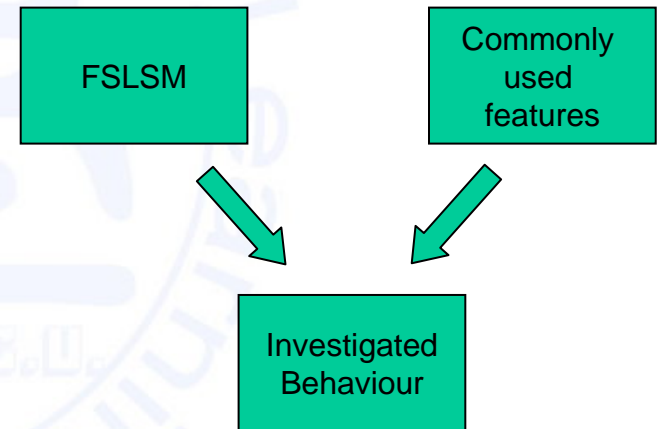
- Object oriented modelling course at an university in Austria
- 127 students participated
- Moodle was used to provide additional learning material and learning opportunities
- Students need to perform 5 assignments and a final exam
- Student interaction with Moodle was tracked
- Students filled out the ILS questionnaire for providing information about their learning style preferences



Investigated Behaviour

- Incorporates only behaviour based on commonly used features in TEL

- Content
- Outlines
- Examples
- Self-assessment tests
- Exercises
- Discussion Forum
- Navigation
- General Patterns



Patterns of Behavior

- Content objects
 - Number of visits
 - Time student spent on content objects
 - Time student spent on content objects including graphics
 - Time student spent on content objects including only text
- Outlines
 - Number of visits
 - Time spent on outlines
- Self-assessment tests (SA-Tests)
 - Number of tests performed
 - Whether all available tests were performed at least once
 - Results on tests
 - Number of questions a learner answers twice wrong
 - Number of revisions before submission
 - Time spent on the test
 - Time a learner checked his/her results
 - Results on specific kinds of questions (facts/concepts, detail/overview, graphics/text, interpreting predefined solutions/generating new solutions)

Patterns of Behavior

- Exercises
 - Number of visits
 - Time students spent on exercises
 - Results on exercises
 - Number of revisions before submission (in combination with SA-Tests)
 - Results on questions about interpreting predefined solutions/generating new solutions (in combination with SA-Tests)
- Examples
 - Number of visits
 - Time spent on examples
- Discussion Forum
 - Number of visits
 - Time spent in the forum
 - Number of postings



Patterns of Behavior

- Navigation
 - Number of times, students skipped learning objects
 - Number of times, students jumped back to the previous learning object
 - Number of visits of the course overview page
 - Time students spent on the course overview page
- General Patterns
 - Scores on final exam
 - Scores on compulsory assignments
 - Overall time students spent in the course
 - Number of logins
 - Overall number of visited learning objects



Method of Analysis

- Requirements
 - Spending more than 5 minutes on the ILS questionnaire (41 students excluded)
 - Submitting at least 3 assignments (10 students excluded)
 - Performing the final exam (16 students excluded)
- 75 Students fulfilled the requirements
- For calculating correlations between behaviour and learning style preferences, rank correlation analysis was used (Kendall's tau)



Results – Active/Reflective Dimension

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trythingsout	social oriented	think about material	impersonal oriented
	forum_visit (-)		forum_visit (+)
	forum_stay (-)		forum_stay (+)
	quiz_que_codedev (-)		exercise_score (+)
	content_stay (-)		content_stay (+)
	nav_skip (-)		nav_skip (+)



Results – Sensing/Intuitive Dimension

existing ways	concrete material	careful with details	new ways	abstract material	not carefule with details
exercise_score (-) slides_visit_diff (+)	exercise_score (-)	forum_visit (+) selfass_ques_detail (+) selfass_ques_factual (+) selfass_ques_conceptual (+) selfass_ques_graphics (+) selfass_ques_text (+) selfass_visit (+) selfass_visit_diff (+) selfass_score (+) exercise_visit (+) exercise_stay (+) quiz_ques_codeint (+) slides_visit_diff (+) nav_overview_stay (+) course_time (+) course_login (+) course_activities (+)	selfass_visit (-) exercise_score (+) slides_visit_diff (-) course_time (-)	exercise_score (+) quiz_ques_codedev (+)	selfass_ques_detail (-) selfass_ques_conceptual (-) selfass_ques_text (-) selfass_visit (-) selfass_score (-) exercise_visit (-) exercise_stay (-) quiz_ques_codeint (-) exam_score (-) course_time (-) course_activities (-)

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Results – Visual/Verbal Dimension

pictures	spoken words	written words	difficulty with visual style
	selfass_ques_overview (+)	example_visit (-)	forum_post (+)
		example_visit_diff (-)	exercise_visit (-)
		example_stay (-)	exercise_stay (-)
			outline_stay (-)

Results – Sequential/Global Dimension

detail oriented	sequential progress	from parts to the whole	overall picture	non-sequential progress	relations/connections
navigation_back (-)	forum_visit (+)	quiz_revision (-)	nav_back (+)	forum_visit (-)	slides_visit_diff (-)
navigation_overview_visit (-)	forum_stay (+)	assignment_score_avg (-)		forum_stay (-)	
	selfass_ques_graphics (+)			forum_post (-)	
	selfass_visit (+)			selfass_ques_overview (-)	
	selfass_visit_diff (+)			selfass_ques_factual (-)	
	slides_visit_diff (+)			selfass_ques_conceptual (-)	
	nav_overview_stay (+)			selfass_ques_graphics (-)	
	course_time (+)			selfass_ques_text (-)	
	course_login (+)			selfass_visit (-)	
	course_activities (+)			selfass_score (-)	
				selfass_visit_diff (-)	
				nav_skip (-)	
				nav_overview_stay (-)	
				course_time (-)	
				course_login (-)	
				course_activities (-)	

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Conclusions & Future Work

- Investigated the correlations between students' behaviour in a LMS and their learning style preferences
- Comparison of our results with other studies (e.g., usage of adaptation features, automatic student modelling, ...)
 - Some of our results are in agreement with existing studies
 - Some are in agreement with FSLSM but are not typically used by studies
 - Some are not explicitly mentioned by FSLSM but appear in our data
- Resulting correlations can contribute in adaptive learning by
 - showing that students with different learning style preferences behave differently in TEL
→ give another indication for the potential of adaptivity based on learning styles
 - providing more information in order to develop more precise adaptation features
 - providing more information in order to improve automatic student modelling



Conclusions & Future Work

- Future Work
 - Incorporating our findings for improving automatic student modelling and the development of adaptation features
 - Further investigate the significant results which were not explicitly mentioned by FSLSM

