Representative characteristics of Felder-Silverman learning styles: An empirical model

Sabine Graf
Vienna University of Technology, Austria
graf@wit.tuwien.ac.at

Silvia Rita Viola
Universita' Politecnica delle Marche, Italy
sr.viola@gmail.com

Kinshuk
Athabasca University Canada
kinshuk@ieee.org

Tommaso Leo
Universita' Politecnica delle Marche, Italy
tommaso.leo@univpm.it

- Learners have different needs

- Learning style play an important role in education

- Learners might have difficulties in learning when the learning style does not match with the teaching style

- Considering learning styles makes learning easier and increases the learning progress

Motivation

- **More and more research is done dealing with learning styles in technology enhanced learning**
  - Investigating how to adapt courses with respect to learning styles
  - Developing adaptive systems
  - Build relationships to student's performance and other characteristics of students
  - Detecting learning style from the behaviour of students in online courses

→ An detailed model of learning styles is needed

Aim:
  Investigate the learning style dimensions of Felder-Silverman learning style model in more detail

Felder-Silverman Learning Style Model

- Richard M. Felder and Linda K. Silverman, 1988
- Learning styles are described in detail
- Each learner has a preference on each of the four dimensions
- Range from +11 to -11 for each dimension
- All assumptions are based on tendencies
- Felder-Silverman learning style model is quite often used in technology enhanced learning

Felder-Silverman Learning Style Model

- **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
    standard procedures – challenges
    patient / not patient with details
  - Visual – Verbal

    learning from pictures – learning from words
  - Sequential – Global
    learn in linear steps – learn in large leaps
    good in using partial knowledge – good in drawing connections
    interested in details – interested in the overview (need "big picture")

- Developed by Felder and Soloman to identify learning styles

- 44 questions

- 11 questions for each dimension

- Each question allows two possible answers indicating a preference for either the one or the other pole of the learning style dimension; e.g. active (+1) or reflective (-1)

- Result: a value between +11 and -11 for each dimension

Examples for the need of more detailed information

- **Adapting to learning styles**
  - What does it really mean to have a balanced learning style? (e.g. balanced active/reflective style)

active   reflective

Trying things out	Collaborate with others	Reflect about the material	Work alone

Trying things out	Collaborate with others	Reflect about the material	Work alone

Trying things out	Collaborate with others	Reflect about the material	Work alone

Examples for the need of more detailed information

- If a learning environment supports learning styles only partially, this has to be considered when drawing conclusions
- Identifying learning style from the behavior of learners
  - Different systems support different characteristics of learning styles
  - Maybe not all components of a learning style dimension can be identified → partial information
- Identifying relationship between learning styles and performance (or other characteristics of learners)
  - Detailed information is necessary to build a more accurate relationship

Case Study

- 207 students from Austria and New Zealand

Aims:

- General issues to verify our sample
- Identifying the impact of groups within learning style dimensions
- Identifying the most representative questions for each dimension

General Issues

- **Distribution:**
  - 57% active
  - 58% sensing
  - 87% visual
  - 56% global

	str/mod	balanced	str/mod
Act/Ref:	24%	61%	15%
Sen/Int:	29%	53%	17%
Vis/Ver:	64%	33%	3%
Seq/Glo:	16%	68%	16%

- Defined semantic groups and assigned the questions from ILS to this groups

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

- e.g.: Q1: I understand something better after I
  - **(a)** try it out.
  - **(b)** think it through.
  - → Group "try something out" for active preference
  - → Group "think about material" for reflective preference

Impact of semantic groups

- **Statistical method: Fisher Linear Discriminant Analysis**

Styles	Semantic groups	Act/ Ref	Sen/Int	Vis/Ver	Seq/Glo
Active	try something out	**0.639**	0.113	**0.536**	0.211
	Social oriented	0.452	0.146	0.190	0.180
Reflective	think about material	**0.597**	0.122	0.486	0.217
	impersonal oriented	**0.698**	0.143	0.175	0.170
Sensing	existing ways	0.237	**0.568**	0.301	0.174
	concrete materials	0.178	**0.777**	0.380	0.245
	careful with details	0.147	0.409	0.329	0.456
Intuitive	new ways	0.193	**0.678**	0.309	0.237
	abstract material	0.225	**0.715**	0.453	0.173
	not careful with details	0.008	**0.699**	0.026	0.151
Visual	pictures	0.238	0.227	**0.944**	0.167
Verbal	spoken words	0.202	0.189	**0.648**	0.171
	written words	0.171	0.199	**1.086**	0.258
	difficulty with visual style	0.297	0.388	**0.789**	0.078
Sequential	detail oriented	0.224	0.218	0.290	**0.800**
	sequential progress	0.100	0.237	0.432	**0.686**
	from parts to the whole	0.123	0.154	0.113	**0.839**
Global	overall picture	0.174	0.186	0.202	**0.819**
	non-sequential progress	0.140	0.175	**0.520**	**0.715**
	relations/connections	0.074	0.278	0.375	**0.869**

Cross-Validation

- **Empirical frequencies analysis**
  - How often does students with e.g. active and reflective learning style answer a specific question with a specific (e.g. active) preference?
  - e.g.: active = 90 %; reflective = 20% → high impact
    active = 60 %; reflective = 55% → low impact
  - Difference of percentages acts as measure
  - Ranking of differences → most representative questions

Cross-Validation: Empirical frequencies analysis

	Rank	Question No.	Question
Active / Reflective	1	37	I am more likely to be considered (a) outgoing. (b) reserved.
	2	1	I understand something better after I (a) try it out. (b) think it through.
	3	13	In classes I have taken (a) I have usually gotten to know many of the students. (b) I have rarely gotten to know many of the students.
	4	25	I would rather first (a) try things out. (b) think about how I'm going to do it.
	5	21	I prefer to study (a) in a study group. (b) alone.
Sensing / Intuitive	1	6	If I were a teacher, I would rather teach a course (a) that deals with facts and real life situations. (b) that deals with ideas and theories.
	2	38	I prefer courses that emphasize (a) concrete material (facts, data). (b) abstract material (concepts, theories).
	3	18	I prefer the idea of (a) certainty. (b) theory.
	4	10	I find it easier (a) to learn facts. (b) to learn concepts.
	5	2	I would rather be considered (a) realistic. (b) innovative.
Visual / Verbal	1	31	When someone is showing me data, I prefer (a) charts or graphs. (b) text summarizing the results.
	2	11	In a book with lots of pictures and charts, I am likely to (a) look over the pictures and charts carefully. (b) focus on the written text.
	3	7	I prefer to get new information in (a) pictures, diagrams, graphs, or maps. (b) written directions or verbal information.
	4	19	I remember best (a) what I see. (b) what I hear.
	5	3	When I think about what I did yesterday, I am most likely to get (a) a picture. (b) words.
Sequential / Global	1	36	When I am learning a new subject, I prefer to (a) stay focused on that subject, learning as much about it as I can. (b) try to make connections between that subject and related subjects.
	2	20	It is more important to me that an instructor (a) lay out the material in clear sequential steps. (b) give me an overall picture and relate the material to other subjects.
	3	8	Once I understand (a) all the parts, I understand the whole thing. (b) the whole thing, I see how the parts fit.
	4	44	When solving problems in a group, I would be more likely to (a) think of the steps in the solution process. (b) think of possible consequences or applications of the solution in a wide range of areas.
	5	4	I tend to (a) understand details of a subject but may be fuzzy about its overall structure. (b) understand the overall structure but may be fuzzy about details.

	Rank	Question No.	Question
Active / Reflective	1	37	I am more likely to be considered (a) outgoing. (b) reserved. [Social behaviour]
	2	1	I understand something better after I (a) try it out. (b) think it through.
	3	13	In classes I have taken (a) I have usually gotten to know many of the students. (b) I have rarely gotten to know many of the students.
	4	25	I would rather first [Trying something out / thinking about material]
	5	21	I prefer to study (a) in a study group. (b) alone.
Sensing / Intuitive	1	6	If I were... facts and real life situations. (b) that deals with... [Concrete / abstract learning material]
	2	38	I prefer courses that emphasize (a) concrete material (facts, data). (b) abstract material (concepts, theories).
	3	18	I prefer... [Existing / new ways]
	4	10	I find it... concepts.
	5	2	I would rather be considered (a) realistic. (b) innovative.
Visual / Verbal	1	31	When... the data, I prefer (a) charts or graphs. (b) text summarizing the results. [Written text]
	2	11	In a book... and charts, I am likely to (a) look over the pictures and charts carefully. (b) focus on the written text.
	3	7	I prefer... rams, graphs, or maps. (b) written directions or verbal information. [Written and spoken words]
	4	19	I remember... (b) what I hear. [Spoken words]
	5	3	When I think about what I did yesterday, I am most likely to get (a) a picture. (b) words.
Sequential / Global	1	36	When I am learning a new subject, I prefer to (a) stay focused on that subject, learning as much about it as I can. (b)... [Sequential progress / relations and connections]
	2	20	It is more important to me that an instructor (a) lay out the material in clear sequential steps. (b) give me an overall...
	3	8	Once I... whole thing, I see how the parts fit. [From parts to the whole / overall picture]
	4	44	When solving problems in a group, I would be more likely to (a) think of the steps in the solution process. (b) think of... in a wide range of areas. [Detail-oriented / overall picture]
	5	4	I tend to (a)... about its overall structure. (b) understand the overall structure but may be fuzzy about details.

Conclusion and Future Work

- Provided an in depth analysis of FSLSM based on data from the ILS questionnaire

- We identified several groups within the learning style dimensions and pointed out their impact on each learning style dimension

- Statistical methods where used and cross-validation was performed

- The results show a more accurate description for FSLSM which is especially important for technology enhanced-learning
  - Leads to a more accurate representation of the student model
  - Improves adaptivity regarding learning styles

Future Work

- **Facilitating concrete applications of the results (e.g. providing a list of features in online environments that addresses the identified semantic groups)**

- **Use additional information of semantic groups for**
  - providing adaptivity
  - detecting learning styles from the behavior of students
  - detecting relationships between learning styles and other characteristics of students