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# Adaptation Rules Relating Learning Styles Research and Learning Objects Meta-data

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**Abstract.** This paper investigates the development of adaptation rules which relate individual learning styles characteristics to learning objects characteristics, as the latter are reflected in the IMS Learning Resource Meta-Data Specification. The paper outlines the most well-known learning styles theories and models, some criteria for selecting among them, as well as a number of adaptive web-based learning environments which are utilising learning styles research for facilitating personalised learning. The paper concludes with the set of adaptation rules which are used in the KOD learning environment, which aims to facilitate individualised access to learning material in a re-usable way.

## 1. Introduction

The rapid evolution of Information and Communication Technologies (ICT) and the emergence of the Knowledge Society create numerous new opportunities for the improvement of the quality of education. It can be argued, however, that education has not yet realised the full potential of the employment of ICT: *"there is a shortage of solid evidence to back up the belief that telematic learning systems provide real advantages"* [1]. Besides the apparent benefits of ICT for delivering education to distance learners independently of time, location, etc, several studies question whether

there is **"***a significant difference***"** with respect to the learning effectiveness when ICT is employed in education [2]. This is mainly due to the fact that the "traditional" mode of instruction (one-to-may lecturing, or one-to-one tutoring) adopted in "conventional" educational technology cannot not fully accommodate the different learning and studying styles, strategies and preferences of diverse learners.

Personalised learning (PL) systems are attracting increasing interest in this context, since they bare the potential to meet the requirements of the knowledge society and knowledge-based economy for high-quality education and training [3]. PL systems can be defined by their capability to automatically *adapt* to the changing attributes of the "learning experience", which can, in turn, be defined by the individual learner characteristics, the type of the learning material, etc. That is, PL systems can be categorised and differentiated in terms of their *adaptation logic*, which is defined by: (i) PL constituents: the aspects of the learning experience which are subject to adaptations; that is, is the learning material being adapted? and if so, how do we categorise learning material so that we can select different content for different learner? (ii) PL determinants: the aspects of the learning experience which "drive" adaptations; that is, are adaptations based on the learner's profile? and if so, how is the learner profile defined? and (iii) PL rules: the rules which define which PL constituents are selected for different PL determinants [4]. PL systems can be quite diversified according to their adaptation logics, depending on the requirements of the specific learning context. For example, PL determinants can include learners' characteristics, which can, in turn, include learner's background, expertise, prior knowledge, skills, requirements, preferences, etc [5].

This paper addresses the incorporation of learning styles research in the adaptation logic of PL systems. That is, the definition of PL determinants, constituents and rules which are based on, and reflect specific learning styles theories and models. The next section provides a short overview of the most well-known learning styles theories and models, as well as some criteria for selecting among them when developing PL systems. Subsequently, the paper outlines some existing PL systems which utilise learning styles research, with emphasis on PL system which has been developed in the context of the KOD "Knowledge on Demand" European project (see acknowledgements section). The paper concludes with the set of adaptation rules used in the KOD project, which attempt to relate individual learning styles characteristics (as adaptation determinants), and learning objects characteristics (as adaptation constituents), as the latter are reflected in the IMS Learning Resource Meta-Data Specification – LOM [6].



## 2. A Brief Overview of Learning Styles

The term "learning styles" has been attributed with several connotations in the literature. Learning styles can be generally described as "an individual's preferred approach to organising and presenting information" [7]; "the way in which learners perceive, process, store and recall attempts of learning" [8]; "distinctive behaviours which serve as indicators of how a person learns from and adapts to his environment, and provide clues as to how a person's mind operates" [9]; "a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour [10].

Learning styles models can be presented through an onion metaphor (proposed in [11]), consisting of three basic layers which categorise learners in terms of instructional preferences (outermost layer), information processing (middle layer) and personality (innermost layer). Social interaction, a fourth layer placed between Curry's two outer layers, was proposed in [12]. The most well-known and used learning styles theories and models are presented in Table 1. For each model, the presentation includes: (i) the learner categorisations proposed by each model, (ii) the existence of an assessment instrument for categorising each learner in the above categories, and (iii) indicative references for each model.

**Table 1.** Overview of Learning Styles

| Name | Learners' Categorisation | Assessment Instrument |
|---|---|---|
| Kolb Learning Style Inventory [13], [14] | Divergers (concrete, reflective), Assimilators (abstract, reflective), Convergers (abstract/active), Accommodators (concrete/active) | Learning Style Inventory (LSI), consisting of 12 items in which subjects are asked to rank 12 sentences describing how they best learn. |
| Dunn and Dunn – Learning Style Assessment Instrument [15], [16] | Environmental, Emotional, Sociological, Physical factors. | (i) Learning Style Inventory (LSI) designed for children grade 3-12; (ii) Productivity Environmental Preference Survey (PEPS) – adult version of the LSI containing 100 items |
| Felder-Silverman – Index of Learning Styles [17], [18] | Sensing-intuitive, Visual-verbal, Indicative-deductive, Active-reflective, Sequential-global | Soloman and Felder questionnaire, consisting of 44 questions |
| Riding – Cognitive Style Analysis [19], [20] | Wholists-Analytics, Verbalisers-Imagers | CSA (Cognitive Styles Analysis) test, consisting of three sub tests based on the comparison of the response time to different items |
| Honey and Mumford – Learning Styles Questionnaire [21] | Theorist, Activist, Reflector, Pragmatist | Honey & Mumford's Learning Styles Questionnaire (LSQ), consisting of 80 items with true/false answers |
| Gregoric – Mind Styles and Gregoric Style Delineator [9], [22] | Abstract Sequential, Abstract Random, Concrete Sequential, Concrete Random | Gregoric Style Delineator containing 40 words arranged in 10 columns with 4 items each; the leaner is asked to rank the words in terms of personal preference |
| McCarthy – 4 Mat System [23], [24] | Innovative, Analytic, Common sense, Dynamic | - |
| Gardner – Multiple Intelligence Inventory [25], [26] | Linguistic, Logical-mathematical, Musical, Bodily-kinesthetic, Spatial, Interpersonal, Intrapersonal | an instrument consisting of 8 questions |
| Grasha-Riechmann – Student Learning Style Scale [27], [28] | Competitive-Collaborative, Avoidant-Participant, Dependent-Independent. | 90 items self-report inventory measuring the preferences of both high school and college students |

| | | |
|---|---|---|
| Hermann – Brain Dominance Model [29], [30] | Quadrant A (left brain, cerebral), Quadrant B (left brain, limbic), Quadrant C (right brain, limbic), Quadrant D (right brain, cerebral) | 120 questions that refer to four profile preferences codes corresponding to each quadrant |
| Mayers-Briggs – Type Indicator [31], [32] | Extroversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judgement, Perception | (i) MBTI (Myers-Briggs Type Indicator), (ii) Kiersey Temperament Sorter I, and (iii) Kiersey Character Sorter II |

### 2.1 Criteria for Selecting Among Different Learning Style Models in PL Systems

Given the variety of learning styles theories and models that are available in the literature, we need to define a set of criteria for selecting the most appropriate learning style model to be accommodated in a specific PL system.

Of course, the most important criterion, apart from the theoretical and empirical justification of the model, is the suitability of each model for the specific learning context under consideration, the available adaptation technologies, etc, especially from an educational point of view. For example, if all learners of a specific learning context are "experts" in the domain (e.g. an application for aircraft pilots), then it might not be reasonable to select a learning style model which categorises learners as being either "experts" or "novices". Similarly, if all the educational material that is available for a specific case is in textual form, then it is not reasonable to select a model which differentiates content according to its medium.

The following paragraphs summarise some additional selection criteria that need to be considered in this context.

- *Measurability:* We need to be able to "measure" how learners are "classified" into the categories defined by each model. For example, one model may differentiate learners according to their emotions; while this may be reasonable from a theoretical point of view, since emotions may affect learning, it may not be reasonable to select such a model for a PL system, since it may be very difficult to measure learners' emotions. The existence of an assessment instrument (e.g. such as the questionnaires included in Table 1) may help in this direction. Moreover, for adaptive learning environments, this classification needs to be performed at run-time, based on the learners' observable behaviour (i.e. it cannot be based on initial questionnaires).
- *Time effectiveness:* The assessment instrument related to each learning style model needs to include a reasonable number of questions in order to be time effective. For example, if an assessment instrument consists of 200 questions, then the instrument may not be effective time wise. The user may not be willing to dedicate his/her time in order to complete a large questionnaire before starting using the system.
- *Cost:* The cost of a learning style model along with its assessment instrument is another parameter that system designers may need to consider. The situation here varies, as some assessment instruments are only available for use after payment, while others are available to be used free-of-charge. Another type of "cost" related to each learning style model is the type of learning material selected for different (categories of) learners; for example, starting from a text-

based learning material, it may not be cost-effective to adopt a visual/verbal learner classification, since this may require that the learning material is enriched with visual multimedia components.

## 3. Some Examples of Accommodating Learning Styles Research in PL Systems

Learning styles research has formed the basis for the development of a number of PL systems, since a number of studies have shown that adaptation to the individual's learning style can have a positive impact on learning effectiveness (e.g. [33]). TrainingPlace.com is a notable example of a commercial PL system which is based on learning styles research. This system is based on Learning Orientation Theory, which categorises learners into transforming, performing, conforming and resistant. Based on this categorisation, the system presents different "learning experiences" to each learner. For example, the system selects "loosely structured environments that promote challenging goals, discovery and self-managed learning" for transforming learners, and "semi-complex, semi-structured, coaching environments that stimulate personal value and provide creative interaction" for performing learners [34].

The INSPIRE system adapts the presentation of the learning material, based on the Honey and Munford's learning styles model, as shown below [35]:

| **learner style** | **selected learning material** |
|---|---|
| activist (motivated by experimentation and challenging tasks) | activity-oriented learning material with high interactivity level |
| reflector (tend to collect and analyse data before taking action) | example-oriented learning material |
| pragmatist (keen on trying out ideas, theories and techniques) | exercise-oriented learning material |
| theorist (preferring to explore and discover concepts through more abstract ways) | theory-oriented learning material |

The same learning styles model is used in SMILE, a web-based knowledge support system aiming at promoting intelligent support for dealing with open-ended problem situations [36]; as well as within the 3DE European Project www.3deproject.com), where different courses are developed for each learner from a repository of learning objects.

The AES-CS system adapts the learning environment based on the field dependent/independent learning styles model, as shown below [37]:

| **field-dependent learners** | **field-independent learners** |
|---|---|
| provide global approach | provide analytical approach |
| provide information from general to specific | provide information from specific to general |
| program control | learner control |
| provide advance organizer | provide post organizer |
| provide maximum instructions | provide minimal instructions |
| provide maximum feedback | provide minimal feedback |

| | |
|---|---|
| provide structured lessons | allow learners to develop their own structure |

The *iWeaver* system adapts the presentation of the learning material, based on the learner's style, following the Dunn & Dunn model, as shown below [38]:

| learner style | recommended representation | representation type |
|---|---|---|
| auditory | PowerPoint-style presentations with synchronous audio, no text | multimedia representation |
| visual (pictures) | diagrams, illustrations, graphs, flowcharts, animations & audio | multimedia representation & text or audio |
| visual (text) | reading, context-aware note-taking tool | text & additional tool |
| tactile kinesthetic | interactive multimedia elements: puzzles, drag-and-drop fill-ins, small games | multimedia representation & text |
| internal kinesthetic | extra examples of real-life relevance, links to prior content | additional text |
| impulsive | try-it button (allows immediate trial) | additional tool |
| reflective | context-aware note-taking tool, questions that encourage reflection | additional tool |
| global | advance organisers or mind maps | additional multimedia representation |
| analytical | sequential lists of key points and components | text (default) |

## 4. Adaptation Rules in the KOD Adaptive Web-Based Learning Environment

The KOD European project aims to promote individualised access to learning material in a re-usable way. This section focuses on the adaptation rules which are used in the KOD project, in order to accommodate learning styles research (the work of the project has been published in [39], [40], [41]).

Following the discussion of the previous section (concerning the selection among the available learning styles theories and models), we should also highlight another important selection criterion: it is important that the selected model describes not only how learners are categorised, but also how instruction should be adapted for each learner category; that it, apart from the descriptive information (e.g. learners are categorised into "active" and "reflective"), the model should provide prescriptive guidelines, which can lead to specific adaptation rules for designing instruction and adaptation (e.g. what types of educational content should be selected for active and reflective learners).

However, learning styles models are usually rather descriptive in nature, in the sense that they offer guidelines as to what methods to use to best attain a given goal; they are not usually prescriptive in the sense of spelling out in great detail exactly what must be done and allowing no variation: "prescription only applies to deterministic or positivistic theories, which are almost nonexistent in the social sciences" [42].

In this context, as part of the KOD project, we "interpreted" the literature on the respective models (presented in Table 1), in order to develop a set of adaptation rules,

which are shown in Table 2. Since KOD aims to build on existing learning technologies specifications, the adaptation constituents (i.e. learning objects characteristics)[1] were selected among the LOM elements.

It should be noted that:

- the values of some of the LOM elements included in Table 2 require an extension of the current version of the specification; for example, the value `theoretical` does not belong into the suggested values of the `educational.learningResourceType` element;
- the values for the `technical.format` element have been selected for presentation purposes to be `visual`, `verbal`, etc; according to the specification, these values should be mapped onto MIME types, based on RFC2048:1996 specification (e.g. `image/jpg` or `image/gif`, etc);
- the adaptation determinants of the rules of Table 2 could also be described through learning technologies specifications, and in particular through the Learner Information Package Specification – LIP [43]; since the LIP specification does not include specific elements for maintaining the learner's learning styles characteristics, the adaptation determinants could be maintained within the (extended) `preference.cognitive` element.

**Table 2.** Example KOD Adaptation Rules

| |
|---|
| **Felder-Silberman Index of Learning Styles** |
| • IF learner=sensing THEN LOM.educational.learningResourceType=exercise OR simulation OR experiment |
| • IF learner=intuitive THEN LOM.educational.learningResourceType=problemStatement OR narrativeText |
| • IF learner=visual THEN LOM.technical.format=visual |
| • IF learner=verbal THEN LOM.technical.format=verbal |
| • IF learner=inductive THEN LOM.educational.semanticDensity=0 OR 1 |
| • IF learner=deductive THEN LOM.educational.semanticDensity=3 OR 4 |
| • IF learner=active THEN LOM.educational.semanticDensity=exercise OR simulation OR experiment |
| • IF learner=reflective THEN LOM.educational.semanticDensity=problemStatement OR narrativeText |
| • IF learner=sequential THEN LOM.educational.semanticDensity=0 OR 1 |
| • IF learner=global THEN LOM.educational.semanticDensity=2 OR 3 |
| **Riding Cognitive Style Analysis** |
| • IF learner=analytic THEN LOM.educational.semanticDensity=0 OR 1 |
| • IF learner=wholist THEN LOM.educational.semanticDensity=2 OR 3 |
| • IF learner=visual THEN LOM.technical.format=visual |
| • IF learner=verbal THEN LOM.technical.format=verbal |

[1] The term "learning object" is used to refer to "any (digital) entity that can be used, re-used, or referenced during technology-supported learning" [6].

**Honey and Mumford Learning Styles**

- IF learner=theorist THEN LOM.educational.learningResourceType=theoretical
- IF learner=activist THEN LOM.educational.learningResourceType=practical
- IF learner=reflector THEN LOM.educational.semanticDensity=0 OR 1
- IF learner=pragmatist THEN LOM.educational.semanticDensity=2 OR 3

**Gregoric – Mind Styles and Style Delineator**

- IF learner=abstractSequential THEN LOM.educational.semanticDensity=0 OR 1
- IF learner=abstractRandom THEN LOM.educational.semanticDensity=2 OR 3
- IF learner=concreteSequential THEN LOM.educational.learningResourceType=exercise OR simulation OR experiment
- IF learner=concreteRandom THEN LOM.educational.learningResourceType=problemStatement OR narrativeText

**Learning Orientation Theory**

- IF learner=transforming THEN LOM.educational.interactivityLevel>2
- IF learner=performing THEN LOM.educational.interactivityLevel>2
- IF learner=conforming THEN LOM.educational.semanticDensity<2

## 5. Conclusions and Future Work

This paper investigates the accommodation of learning styles research in PL systems. It briefly reviews the most well-known learning styles theories and models, as well as some criteria for selecting among them, and also outlines a number of PL systems which utilise this line of research for delivering personalised learning.

The emphasis of the paper is on the PL system which has been developed in the context of the KOD European project, and, moreover, on the adaptation rules which have been used in the KOD system, based on learning styles research.

As it was described earlier, the "rule templates" employed in KOD (shown in Table 2) are the result of an "interpretation" of the literature on the respective models, which was carried out within the project. Part of our current and future work involves the validation of these "prescriptive rules", through the development and testing of adaptive learning material which is based on them. The KOD project, facilitating the interchange of learning material in a re-usable way [40], offers an effective test-bed for this endeavour.



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## References


1. European Commission, Future European RTD Agenda for Technology Enabled Learning, Report on the 1st Consultation Meeting, Luxembourg, March 23-24, 2000.
2. Russell T.L., The No Significant Difference Phenomenon as reported in 355 Research Reports, Summaries and Papers: A Comparative Research Annotated Bibliography on Technology for Distance Education, North Carolina State University, Office of Instructional Telecommunications, 1999.
3. Brusilovsky P., Adaptive and Intelligent Technologies for Web-based Education, Kunstliche Intelligenz, Special Issue on Intelligent Systems and Teleteaching, 4, 1999.
4. Stephanidis C., Karagiannidis C. and Koumpis A., Decision Making for Intelligent User Interfaces, 3rd ACM International Conference on Intelligent User Interfaces (IUI 97), Orlando, Florida, January 1997.
5. Brusilovsky P., Adaptive Hypermedia, User Modeling and User-Adapted Interaction, 11(1), 2001.
6. IMS Global Learning Consortium, Learning Resource Meta-Data Specification, Version 1.2.1, September 2001. Electronically available from http://www.imsglobal.org/ metadata/index.cfm.
7. Riding R & Rayner S., Cognitive styles and learning strategies: Understanding style differences in learning and behaviour, David Fulton Publishers, 1998.
8. James W., & Gardner D., Learning styles: Implications for distance learning, New Directions for Adult and Continuing Education, 67, 1995
9. Gregoric A., Learning/teaching styles: Potent forces behind them, Educational Leadership, 36(4), 1979.
10. Keefe J., & Ferrell B., Developing a Defensible Learning Style Paradigm, Educational Leadership, 48 (2), 1990
11. Curry L., An Organisation of Learning Styles Theory and Constructs, American Educational Research Association Conference, Montreal, Quebec, 11-15 April, 1983.
12. Claxton C., & Murrell P., Learning Styles: Implications for Improving Education Processes, ASHE-ERIC Higher Education Report No 4, Association for the Study of Higher Education, 1987.
13. Kolb A., Experiential Learning: Experience as the Source of Learning and Development, Prentice Hall, 1984.
14. Kolb A., LSI Learning-Style Inventory, McBer & Company, 1985.
15. Dunn R., & Dunn K., Teaching Students through their Individual Learning Styles: A Practical Approach, Reston Publishing Company, 1978.
16. Dunn R., & Dunn K., The Complete Guide to the Learning Styles Inservice System, Allyn & Bacon, 1999.
17. Felder R., & Silverman L., Learning and Teaching Styles in Engineering Education, Engineering Education, 78(7), 1988.
18. Felder R., Matters of Style, ASEE Prism, 6(4), 1996.
19. Riding R., & Cheema I., Cognitive Styles: An Overview and Integration, Educational Psychology, 11(3&4), 1991.
20. Riding R., Cognitive Styles Analysis, Learning and Training Technology, 1994.
21. Honey P., & Mumford A., The Manual of Learning Styles, 3rd Ed., Maidenhead, Peter Honey, 1992.
22. Gregoric A., Style Delineator, Maynard MA, Gabriel Systems, 1982.
23. McCarthy B., The 4MAT System: Teaching to Learning Styles with Right/Left Mode Techniques, Excel. Inc, 1980.
24. McCarthy B., A Tale of Four Learners: 4MAT's Learning Styles, Educational Leadership, 1997.
25. Gardner H., Frames of Mind: The Theory of Multiple Intelligences, 2nd Ed., Fontana, 1993.

26. Gardner H., Multiple Intelligences: The Theory in Practice, Basic Books, 1993.
27. Hruska-Riechmann S., & Grasha A., The Grasha-Riechmann Student Learning Style Scales: Research Findings and Applications, in Keefe J. (ed.), Student Learning Styles and Brain Behaviour, Reston, 1982.
28. Grasha A., Teaching with Style: A Practical Guide to Enhancing Leaning by Understanding Teaching and Learning Styles, Alliance Publishers, 1996.
29. Herrmann N., Herman Brain Dominance Instrument, Lake Lure, Applied Services, 1982.
30. Herrmann N., The Creative Brain, Lake Lure, Brain Books, 1995.
31. Myers I., & Kirby L., Introduction to Type Dynamics and Development, Consulting Psychologists Press, 1994.
32. Myers I., McCaulley M., Quenk N., & Hammer L., The MBTI Manual: A guide to the Development and Use of the Myers-Briggs Type Indicator, Consulting Psychologists Press, 1998.
33. Graff M., Assessing Learning from Hypertext: An Individual Differences Perspective, Journal of Interactive Learning Research, 14(4), 2003.
34. Martinez M., & Bunderson C., Foundations for Personalised Web Learning Environments, ALN Magazine, 4(2), 2000.
35. Papanikolaou K., Grigoriadou M., Kornilakis H., & Magoulas G., Personalising the Interaction in a Web-based Educational Hypermedia System: the case of INSPIRE, User-Modeling and User-Adapted Interaction, 13 (3), 2003.
36. Stoyanov S., & Kommers P., Agent-Support for Problem Solving Through Concept-Mapping, Journal of Interactive Learning Research, Special issue on Intelligent Agents fro Educational Computer-Aided Systems, 10(3/4), 1999.
37. Triantafyllou E., Pombortsis A., & Demetriadis S., The Design and the Formative Evaluation of an Adaptive Educational System Based on Learning Styles, Computers and Education, 41, 2003.
38. Wolf C., iWeaver: Towards an Interactive Web-Based Adaptive Learning Environment to Address Individual Learning Styles, European Journal of Open and Distance Learning, 2002.
39. Karagiannidis C., Sampson D., & CardinaliF., Integrating Adaptive Educational Content into Different Courses and Curricula, Educational Technology & Society Journal, IEEE Learning Technology Task Force, Special Issue on “Curriculum, Instruction, Learning and the Internet”, 4(3), July 2001.
40. Sampson D., Karagiannidis C., & Cardinali F., An Architecture for Web-based e-Learning Promoting Re-usable Adaptive Educational e-Content, Educational Technology & Society Journal, IEEE Learning Technology Task Force, Special Issue on Innovations in Learning Technology, 5(4), August 2002 (Invited Paper).
41. Sampson D., Karagiannidis C. & Kinshuk, Personalised Learning: Educational, Technological and Standardisation Perspectives, Interactive Educational Multimedia, 4, April 2002.
42. Reigeluth C.M., The Elaboration Theory: Guidance for Scope and Sequence Decisions, in Reigeluth C.M. (ed.), Instructional-Design Theories and Models Volume II, Lawrence Erlbaum Associates. p. 425-453, 1999.
43. IMS Global Learning Consortium, Learner Information Package Specification, Version 1.0, March 2001. Electronically available from http://www.imsglobal.org/profiles/index.cfm.