An Innovative Use of Learning Objects and Learning Style in Pedagogic Agent Systems

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Motivation

- Adaptivity in education is increasingly demanded in order to improve the efficiency and effectiveness of the learning process.

- Few intelligent learning systems exist which are dynamic and able to provide personalized learning materials to satisfy individual students' requirements.

A Solution

- Takes a multi-disciplinary approach, combining learning theory with agent-based systems.

- An agent-based learning system that incorporates learning objects to facilitate personalization, and is based on a learning style theory as the pedagogic foundation for adaptivity.

Learning Objects

- A learning object is a self-standing, reusable, discrete piece of content that meets an instructional objective.

- The decomposition of educational content into learning objects permits an individual learning object to be used in a variety of educational contexts.

Learning Style Theories

- "A description of the attitudes and behaviours that determine our preferred way of learning."

  - Peter Honey

- Learning Style Theories and Models

Agent Technology

- Autonomy, proactiveness, responsivity, and adaptivity.

- Multi-agent systems provide a natural basis for training decision makers in education and training.

Felder-Silverman Learning Style Model – 1

- It has been validated by pedagogy research (Zywno 2003, Felder & Spurlin 2005).

- The number of dimensions of the model is constrained, improving the feasibility of its implementation.

Felder-Silverman Learning Style Model - 2

- *Sensing* (concrete thinker, practical,…) or *Intuitive* (abstract thinker, innovative,…);

- *Visual* (prefer visual representations of presented material,…) or *Verbal* (prefer written and spoken explanations,…);

- *Active* (learn by trying things out,…) or *Reflective* (learn by thinking things through,…);

- *Sequential* (linear thinking process,…) or *Global* (holistic thinking process,…).

Pedagogic Incorporation of Learning Objects and Learning Style

- The Learning Object Agent is responsible for incorporating the learning style scheme and the learning objects.

- Implementation divided into three parts,

  - accommodating students into the learning style scheme;

  - categorizing learning objects according to the learning style scheme; and

  - delivering learning objects.

Accommodating Students into the Learning Style Scheme – 1

- Felder and Silverman use a complex questionnaire (containing 44 questions) to ascertain a student's learning style (Soloman & Felder 2004) .

- The information supplied would be more than such a system would require to operate effectively.

- A set of four questions for each dimension has been chosen (total of 16 questions).

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# Accommodating Students into the Learning Style Scheme – 2

- Students have answered both of the 44 questions and the 16 questions.

- Data have been normalized into one scale.

  - The original answers of the 44 questions are on a scale of 0-10 on each dimension.

  - According to the interpretation of the score, the results are normalized into a five-point scale.

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Accommodating Students into the Learning Style Scheme – 3

- The results of the reduced set of 16 questions are also based on a five-point scale.

- Both of the normalized data sit in the interval [0, 1].

- A Spearman's rank correlation coefficient statistical analysis has been performed on the normalized data, and indicates a strong correlation between the two data sets.

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Categorizing Learning Objects according to the Learning Style Scheme – 1

- The learning object metadata incorporates a *dimension description*.

- Suggesting for each of the four learning style dimensions the extent of each object's suitability on a five-point scale, e.g.

Active   **Reflective**

■————————■————————■————————■————————■

Strongly   Weakly   Neutral   Weakly   Strongly
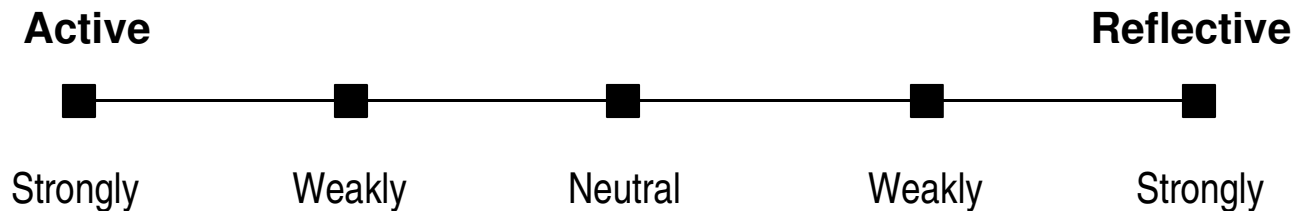
Categorizing Learning Objects according to the Learning Style Scheme – 2

- Users have classified the available learning objects according to the five-point scale category.

- Initial results are promising.

- Further investigation of the granularity is ongoing.

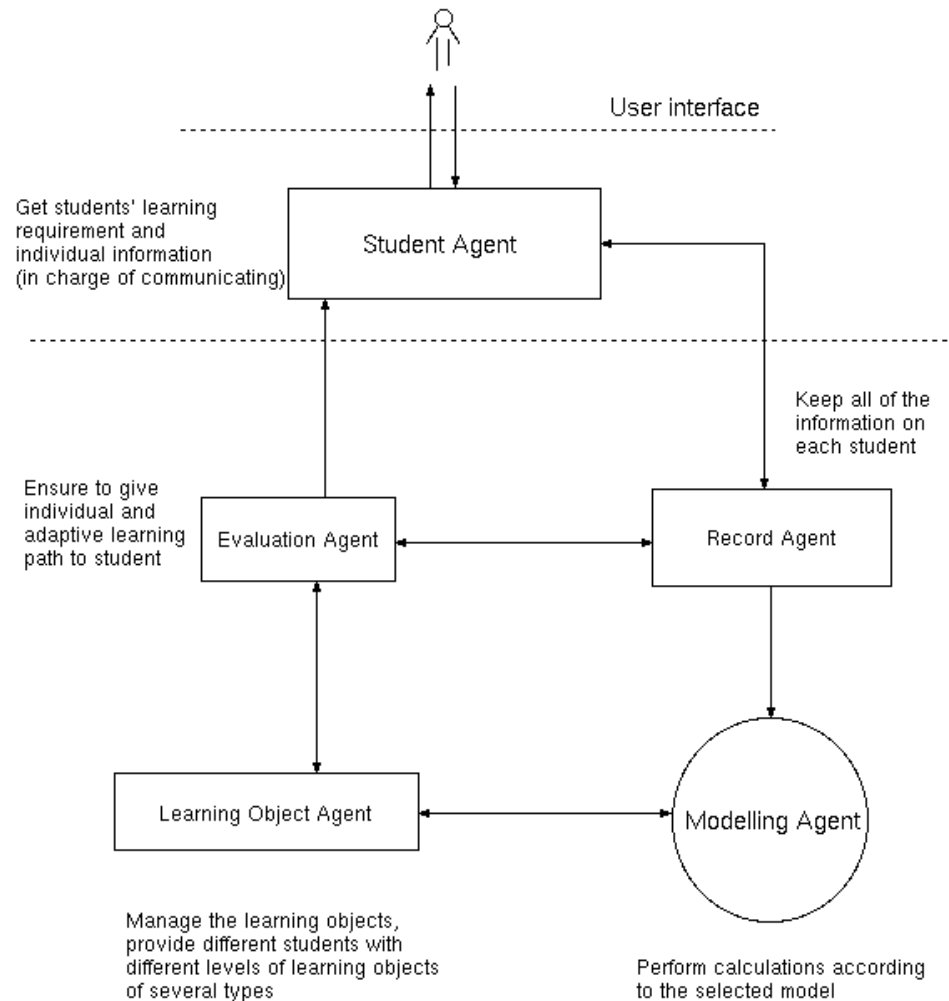# Delivering Learning Objects for Different Learning Styles – 1

- The system stores each student's current learning style (which may change over time), and the style attributes of each learning object, as co-ordinates in the four-dimensional space.

- The algorithm involves matching the style attributes of (appropriate) learning objects to the current style preferences of the individual student.

- Supported by agent technology to realize the algorithm and implement the process.

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Delivering Learning Objects for Different Learning Styles – 2

- Both the categorization of a learning object and the assignment of a learning style to a student are necessarily approximate.

- A simulation, which covered all of the possibilities, has been run on the system.

- The evaluation indicates that the approach is capable of delivering different learning objects to different students according to the learning style category.

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The Multi-Agent Education System

- Student Agent

- Record Agent

- Modelling Agent

- Learning Object Agent

- Evaluation Agent

User interface

Get students' learning requirement and individual information (in charge of communicating)

Student Agent

Keep all of the information on each student

Ensure to give individual and adaptive learning path to student

Evaluation Agent

Record Agent

Learning Object Agent

Modelling Agent

Manage the learning objects, provide different students with different levels of learning objects of several types

Perform calculations according to the selected model

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Conclusion

- We have described the use of learning objects and learning style in an agent-based learning system to enhance adaptivity.

- At the conceptual level, adaptivity is achieved by the use of learning style schemes to tailor the presentation of learning objects to individual students.

- At the practical level, this adaptivity is achieved by providing a set of agents that uses a combination of pre-built and acquired knowledge to determine the learning styles and learning objects that are appropriate for individual students.

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Future Work

- Optimizing the architecture.

- Evaluation of the system effectiveness and efficiency.

- Investigation of the granularity in the category of learning objects.