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).
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.
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.
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.

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Active

Strongly    Weakly    Neutral    Weakly    Strongly

Reflective

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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.
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.
The Multi-Agent Education System

- Student Agent
- Record Agent
- Modelling Agent
- Learning Object Agent
- Evaluation Agent

User Interface

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

Evaluation Agent
- Ensure to give individual and adaptive learning path to student

Record Agent
- Keep all of the information on each student

Learning Object Agent
- Manage the learning objects, provide different students with different levels of learning objects of several types

Modelling Agent
- Perform calculations according to the selected model
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.
Future Work

• Optimizing the architecture.

• Evaluation of the system effectiveness and efficiency.

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