Enhancing the Adaptive and Adaptable Functionality of Adaptive Educational Hypermedia Systems

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DESCRIPTION OF RESEARCH AREA

The Educational and Language Technology Group belongs to the division of Computer Systems and Applications of the Department of Informatics and Telecommunications, University of Athens. The research interests of the Educational and Language Technology Group are: (*i*) *Adaptive and Intelligent Learning Environments & Distance Learning*: artificial and computational intelligence methods in knowledge representation and learner modeling, instructional design, computer-supported collaborative learning environments, agent-based architectures, (*ii*) *Educational Software,* and *(iii) Language Technology*. The research group involved in the area of *Adaptive Educational Hypermedia Systems* includes: Maria Grigoriadou (Head of the group, Associate Prof. Univ. of Athens), and the research assistants, Kyparisia Papanikolaou (PhD and also affiliated with the Univ. of Piraeus), Grammatiki Tsaganou (PhD), Evangelia Gouli (MSc., PhD Candidate), Agoritsa Gogoulou (MSc., PhD Candidate), Stefanos Ziovas (MSc., PhD Candidate). More information on the activities of the group can be found on http://hermes.di.uoa.gr

RESEARCH ACTIVITIES ON ADAPTIVE EDUCATIONAL HYPERMEDIA

Adaptive Educational Hypermedia Systems (AEHS) (Brusilovsky, 2001) are a relatively recent area of research that aims at overcoming the inability of traditional educational hypermedia systems to support the learning needs of a heterogeneous learning community. Open issues regarding the design of AEH systems include: (i) learner modeling: content, structure of the learner model, and learner diagnosis, (ii) instructional design: domain knowledge (content, structure, representation), assessment process, feedback, collaboration, (iii) adaptive engine: selection of appropriate adaptive technologies depending on the learner and the context, learner control issues, (iv) authoring process: facilitation of the use of AEH systems in real conditions and exploitation of standards (IMS, SCORM, LOM), (v) evaluation of the efficiency and effectiveness of the adaptation. Our goal is to address some of the abovementioned issues with the aim to balance the two different perspectives of such systems, the technological and the educational ones.

Designing AEH systems and authoring tools

In our research we investigated learners' individual differences (Chen and Paul, 2003) and especially the area of learning styles in order to model the learner and his/her interaction with the system, and we proposed an adaptation scheme that uses as sources of adaptation learners' knowledge level and learning style (Papanikolaou et al., 2002). This adaptation scheme is based on a comprehensive instructional framework, which unifies several processes that underlie system's adaptation such as structuring the domain knowledge, developing the educational material, planning adaptive instruction and assessment. Based on this approach we have developed INSPIRE (INtelligent System for Personalized Instruction in a Remote Environment, http://hermes.di.uoa.gr/inspire) (Papanikolaou et al., 2003) which is a web-based AEH system

designed to support Web-based instruction. As far as the learner modelling is concerned we have proposed a diagnosis process of learner's knowledge level based on ideas from the fields of fuzzy logic and multicriteria decision-making with the aim to deal with uncertainty in learners' assessment (Grigoriadou et al., 2002). We currently work on (i) extending INSPIRE's instructional framework in order to support a variety of instructional approaches and enhance the learner control opportunities offered (Papanikolaou and Grigoriadou, 2004) and developing an open source version of the system, (ii) investigating the educational background that should underlie adaptation with the aim to build a meta-adaptive system capable of dynamically selecting the most appropriate adaptation technology following the individual characteristics of the current learner and context, (iii) extending this research to the authoring process of AEH systems we intend also to accommodate the diversity of needs & perspectives of teachers and investigate how the standards could support this process.

Selected Publications

1. Papanikolaou K., Grigoriadou M. (2004), Building an instructional framework to support learner control in Adaptive Educational Hypermedia Systems. In: G. Magoulas and S.Chen (eds.): *Advances in Web-based Education: Personalized Learning Environments*, to appear.
2. Papanikolaou K., Grigoriadou M., Kornilakis H., & Magoulas G.D. (2003), Personalising the Interaction in a Web-based Educational Hypermedia System: the case of INSPIRE, *User-Modeling and User-Adapted Interaction*, 13 (3), 213-267.
3. Papanikolaou K., Grigoriadou M., Magoulas G.D., & Kornilakis H. (2002), Towards New Forms of Knowledge Communication: the Adaptive Dimension of a Web-based Learning Environment. *Computers and Education*, 39 (4), 333-360.
4. Grigoriadou, M., Kornilakis, H., Papanikolaou, K., & Magoulas, G. (2002), Fuzzy Inference for Student Diagnosis in Adaptive Educational Systems. In: I.P. Vlahavas and C.D. Spyropoulos (eds.): Methods and Applications of Artificial Intelligence. *Lecture Notes in Artificial Intelligence*, Vol. 2308, 191-202.

Open Learner Modeling Issues

Open learner modelling engages the learner in the diagnosis process (Dimitrova et al., 2000; Bull and Nghien, 2002). Open issues in this area remain: the way of conveying information about learner modelling to learners, the role of learners as participants in the learner modeling process, the extent to which the selected components of learner modelling are made overt to the learner and the maintenance of learner models. In our research we concentrate on the role of learners as participants in the learner modeling process and we have proposed an open learner modelling approach for modelling learners' historical text comprehension, which is based on dialogue (Tsaganou et al., 2003). This approach provided the theoretical basis for the design of W-ReTuDiS (Web-based Reflective Tutorial Dialogue System http://hermes.di.uoa.gr/retudis), which generates appropriate tutorial dialogue based on the Theory of Inquiry Teaching (Collins, 1987) with the aim to promote learner's reflection (Grigoriadou et al., 2004). Our future plans concentrate on the diagnosis of learner's computer science text comprehension.

Selected Publications

1. Tsaganou G., Grigoriadou M., & Cavoura Th. (2003), Experimental Model for Learners' Cognitive Profiles of Historical Text Comprehension, *International Journal of Computational Cognition*, 1(4), 31-51.
2. Tsaganou G., Grigoriadou M., Cavoura Th., & Koutra D. (2003), Evaluating an Intelligent Diagnosis System of Historical Text Comprehension, *Expert Systems with Applications*, 25(4), 493-502.
3. Grigoriadou M., Tsaganou G., & Cavoura Th. (2004), Dialogue-Based Personalized Reflective Learning, *The 4rd IEEE International Conference on Advanced Learning Technologies (ICALT2004)*, Aug. 30-Sept 1, Joensuu, Finland, to appear.

Assessment Issues

In AEH systems, assessment provides a way to estimate learners' knowledge level usually through learners' responses in assessment tests and/or their navigation through the content. Open research issue in this area is the design of assessment based on evidence derived from observation of what learners say, do or make in assessment activities. In this context, our goals concern: (i) the development of adaptive assessment tests (Gouli et al. 2002), and (ii) the development of alternative assessment techniques that encourage self-assessment and exploit alternative assessment tools such as concept maps. We currently develop an adaptive web-based concept map assessment tool, named COMPASS (COncept MaP ASSessment tool) (Gouli et al. 2004a), which supports learners in accomplishing assessment activities and especially concept mapping tasks. Aiming to stimulate learners to reflect on their errors, COMPASS incorporates different types of feedback such as visual (concept map annotation) and verbal feedback (informative and tutoring feedback components) (Gouli et al. 2004b), accommodating learners' individual differences.

Selected Publications

1. Gouli, E., Papanikolaou, K., & Grigoriadou, M. (2002), Personalizing assessment in adaptive educational hypermedia systems. In: P. De Bra, P. Brusilovsky & R. Conejo (Eds): Adaptive Hypermedia and Adaptive Web-based Systems, Second International Conference, *LNCS 2346*, pp. 153-163, Springer-Verlag, Berlin.
2. Gouli, E., Gogoulou, A., Papanikolaou, K., & Grigoriadou, M. (2004a). COMPASS: An Adaptive web-based COncept Map Assessment tool. In the *Proceedings of the First International Conference on Concept Mapping*, Pamplona, Spain, September 2004, to appear.
3. Gouli, E., Gogoulou, A., Papanikolaou, K., & Grigoriadou, M. (2004b). Designing an Adaptive Feedback Scheme to Support Reflection in Concept Mapping. In the *Proceedings of the Workshop on Individual Differences in Adaptive Hypermedia in AH2004*, to appear.

Collaboration Issues

In the context of Computer-Supported Collaborative Learning environments (CSCL), a number of research efforts are focused on the study of the group dialogue in terms of the skills developed and the enrichment of the communication tools with specific features that promote communication (Soller 2001; Robertson et al., 1998; Barros & Verdejo 2000). Our research in this area is concentrated on the development of an adaptive synchronous communication tool called ACT (Adaptive Communication Tool) which provides learners with a set of "communication-scaffolding" tools (sentence openers/communication acts) based on learner's cognitive and communication skills and the group's individual characteristics such as the model of collaboration that the group members adopt (Gogoulou et al., 2004). Our near future plans include the enhancement of the adaptation features of the tool such as sorting the provided "communication-scaffolding" tools according to the learner's interaction behavior, as well as the development and incorporation of a "collaborative" tutoring agent to the ACT tool, which will support collaboration and guide the learners appropriately towards productive/deliberative discussions.

Selected Publications

1. Gogoulou, A., Gouli, E., Grigoriadou, M., & Samarakou, M. (2004), Adapting the "Communication-Scaffolding" Tools in a Web-based Collaborative Learning Environment, In *Proceedings of the ED-MEDIA 2004, World Conference on Educational Multimedia*, Hypermedia & Telecommunications, Vol. 2004 (1), 1153-1161.

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Barros, B., Verdejo, F. (2000), Analysing student interaction processes in order to improve collaboration. The DEGREE approach. *International Journal of Artificial Intelligence in Education*, 11, 221-241.

Bull, S., Nghien, Th. (2002), Helping Learners to Understand Themselves with a Learner Model Open to Students, Peers and Instructors. In: P. Brna, V. Dimitrova (eds): *Proceedings of Workshop on Individual and Group modelling Methods that Help Learners Understand Themselves*. International Conference on Intelligent Tutoring Systems 2002, 5-13.

Chen, S.Y., Paul, R.J. (eds.) (2003), Special issue on individual differences in web-based instruction. *British Journal of Educational Technology*, 34(4), 385.

Collins, Al. (1987), A Sample Dialogue Based on a Theory of Inquiry Teaching. In: Ch. Reigeluth (ed.): *Instructional Theories in Action*, Lawrence Erlbaum Associates Inc., Hillsdale.

Dimitrova, V., Self, J., Brna, P. (2000), Involving the Learner in Diagnosis - Potentials and Problems. *Tutorial at Web Information Technologies: Research, Education and Commerce*, Montpellier, France.

Robertson, J., Good, J., Pain, H. (1998), BetterBlether: the design and evaluation of a discussion tool for education. *International Journal of Artificial Intelligence in Education,* 9, 219-236.

Soller, A. (2001), Supporting Social Interaction in an Intelligent Collaborative Learning System. *International Journal of Artificial Intelligence in Education*, 12, 40-62.