
Introduction

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Abstract: This opening paper introduces the special issue on 'Authoring of adaptive and adaptable hypermedia', which is based on selected, invited and revised papers from a workshop series on the same topic, as well as on an open call. We hope that this selection can give the reader a feeling about current hot topics and unsolved problems in this field, on one hand, and about the current state-of the art, on the other. Long considered secondary to the research into adaptive hypermedia, the authoring of such systems brings its own issues, particularities, and new exciting problems for the world of research at large to try and tackle. For educational practitioners, this selection gives them some insight into the direction educational systems can and might be moving, and a more clear idea of what to expect from technology.

Keywords: authoring; Adaptive Hypermedia; AH; Adaptive Educational Hypermedia; AEH; adaptive author assistance; semi-automatic adding; authoring model; authoring tool; adaptive web application engineering and authoring; adaptive learning; adaptive systems; tailored information; attention to diversity; IMS learning design; user quality of experience; workplace learning; semantic desktop; metadata; RDF; CAF.

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Biographical notes: Dr. Alexandra Cristea (PhD, University of Electro-Communications, Tokyo, Japan, 1999) is an Associate Professor in the Department of Computer Science at the University of Warwick and Head of the Intelligent and Adaptive Systems group. Her research interests include adaptive educational systems, authoring of AH, user modelling, ITS, semantic web technologies, concept mapping and AI, on which she published more than 100 papers. She is leading a Minerva project entitled 'Adaptive learning spaces' since October 2006. She was an Assistant Professor at the Eindhoven University of Technology, the Netherlands. She (co-)organised workshops, and was panellist and PC member of various conferences. She is executive peer reviewer of *IEEE LTF Education Technology and Society Journal* and co-editor of the *Advanced Technologies and Learning Journal*.

Dr. Rosa M. Carro is an Associate Professor in the Department of Computer Science at the Universidad Autónoma de Madrid (PhD, 2001). Her research focuses on adaptive hypermedia (since 1997), adaptive e-learning systems, collaborative learning, authoring of adaptive and collaborative hypermedia, ubiquitous training and evaluation. She worked at the research unit Mathematics and Applications, Mathematics Department, University of Aveiro (2001–2002). She visited, funded by DAAD, the group Applied Informatics – Cooperative Systems, Department of Informatics, Technical University of Munich, for research on collaborative and adaptive web-based systems (2002–2003). She has been User Modelling Researcher since 2003. She co-organised several workshops and invited sessions in conferences and is reviewer for journals and PC member/reviewer of several conferences related to her research fields.

1 Introduction

This special issue is based on, but not limited to, a series of international workshops with the same name: A3H@AH'06, A3EH@AIED'05, A3EH@AH'04, and A3EH@WBE'04. The focus was aimed to be on issues of design, implementation and evaluation of general adaptive and adaptable hypermedia, with applications in e-learning, e-government, corporate systems and e-commerce.

Authoring of Adaptive Hypermedia (A3H) has long been considered as secondary to adaptive hypermedia (Brusilovsky, 2004) delivery. However, this task is not trivial at all. There exist some approaches to help authors to build adaptive-hypermedia-based systems, yet there is a strong need for high-level approaches, formalisms and tools that support and facilitate the description of reusable adaptive websites and learning environments. Only recently have we noticed a shift in interest, as it became clearer that the implementation-oriented approach would forever keep adaptive hypermedia away from the 'layman' author. The creator of adaptive hypermedia cannot be expected to know all facets of this process, but can be reasonably trusted to be an expert in one of them. For instance, an e-learning courseware author can be expected to be a domain specialist, but not a pedagogy specialist. It is therefore necessary to research and establish the components of an adaptive hypermedia system from an authoring perspective, catering for the different author personas that are required. This type of research has proven to lead to a modular view on the adaptive hypermedia. One of these modules, which is most frequently used, is the User Model, also called Learner Model in the Educational field (or Student Model in ITS). Less frequent, but also emerging as an important module, is the Pedagogical Model (this model also has different names in different implementations, too various to name here). Other component models appearing can be: domain model, goal and constraints model, adaptation model. This special issue endeavoured to look at how adaptive hypermedia can be created in an easier, more systematic way, based on reuse, automatisation, flexible models and on emerging standards. Therefore, questions that it attempted to answer include:

- Are richer user models more efficient for users, and how can they be authored?
- How to support adaptation scenarios?

- How can we consider user cognitive styles in adaptive hypermedia (from an authoring perspective)?
- Are there any recurring patterns that can be detected in the authoring process generally speaking?

The questions were grouped around some major themes, as follows:

- design patterns for adaptive hypermedia
- authoring rich user models for adaptive/adaptable hypermedia
- authoring pedagogic models for adaptive/adaptable educational hypermedia
- authoring for mobile adaptive hypermedia
- generic authoring for adaptive/adaptable hypermedia
- authoring patterns for rich user models in adaptive/adaptable hypermedia
- authoring tools for rich user models in adaptive/adaptable hypermedia
- generic authoring tools in adaptive/adaptable hypermedia
- reusable user models and adaptation models
- authoring personas (roles: *e.g.*, domain author, adaptation author, *etc.*) for adaptive hypermedia
- authoring adaptation languages for adaptive hypermedia
- evaluation of authoring tools for adaptive hypermedia
- evaluation of adaptive hypermedia design patterns
- evaluation of adaptive hypermedia authoring patterns.

These were the questions and themes that we selected as important for this field, and that we have proposed to the research community. The responses, however, whilst covering some of the questions and themes, brought up new questions and interesting issues as well – a proof of the dynamics and breadth of the field of authoring of adaptive (educational) hypermedia (A(E)H).

In the following, we will shortly analyse the papers finally selected in the special issue, from the point of view of matching the initial set of themes and questions that we asked, as well as from the point of view of new trends that they uncover. We strongly recommend the reader to refer to the actual papers for more details, if we, as hoped, managed to wet his/her appetite.

2 Contents

The papers were grouped according to the research life cycle in this field in particular (and in any field in general): first, we have two papers on theoretical issues around authoring of adaptive hypermedia; next, we have three papers on specific

implementation issues discussed for different setups (game-based AEH, web-service solutions, workplace learning); the final two papers focus on applying and evaluating authoring of adaptive hypermedia.

- 1 'Quality of Experience-LAOS: create once, use many, use anywhere' (Muntean *et al.*, 2007) – This paper refines further on the modularisation of authoring levels for adaptive hypermedia, extending a known model of AEH authoring (Cristea and De Mooij, 2003) with the data and rule models necessary to cater for quality of experience. This paper in particular targets questions 2 and 4, and themes 1, 5, 8, 10 and 11. This paper in particular recognises the limitations of current models in the face of new requirements and proposes a more comprehensive solution.
- 2 'Authoring adaptive educational hypermedia on the semantic desktop' (Hendrix *et al.*, 2007) – This paper is theoretical, from the point of view of describing formulas and patterns for knowledge conversion between two domains: semantic desktop and authoring of AEH. However, it also implements this theory in an authoring system, MOT, and performs real-life evaluations, therefore touching questions 2 and 4, and themes 1, 3, 5, 8, 10, 11, 12, 13 and 14. The novelty, beside the theoretical propositions, lies in the bringing of two relatively disjunctive fields together.
- 3 'Authoring game-based adaptive units of learning with IMS Learning Design and <e-Adventure>' (Burgos *et al.*, 2007) – This paper also combines theory with implementation, by describing how adaptation can be inserted into IMS LD environments. In this sense, it targets questions 2 and 4, and themes 1, 3, 5, 8 and 10. A new trend identified here is the learning via adaptive games, thus merging three fields together: games, adaptation and education.
- 4 'Adaptive educational hypermedia interoperability and content creation with a web service-based architecture' (Meccawy *et al.*, 2007) – This paper is implementation-oriented in the sense that it looks at a practical solution for interfacing authoring environments with delivery environments, moving from the system-dependent authoring paradigm towards the create-once, use-many paradigm. It also analyses current state-of-the art approaches to the issue of reuse and interfacing, especially from the point of view of existing systems. As such, it replies to question 4, and targets themes 1, 9 and 10. This paper follows the trend to move web interaction, including authoring of AEH, to web services interaction. It raises interesting questions for implementers of interfacing solutions.
- 5 'Specification, authoring and prototyping of personalised workplace learning solutions' (Dolog *et al.*, 2007) – This paper looks at the issue of authoring from the point of view of moving towards adaptive workplace learning environments, and as such, it is a synthesis of theories, tools and applications that are, or can be used for workplace learning. It touches therefore all questions (1–4) above, and themes 1, 3, 5, 8, 9, 10 and 11. The novelty is bringing authoring solutions to a new application field, that of workplace learning. This paper, as well as the PROLEARN deliverable it is based on, can serve as a guide in this respect for practitioners, implementers but also for higher level decision-makers.

- 6 'Adaptive hypermedia in secondary schools: from the teacher to the student' (Muñoz and Ortigosa, 2007) – This paper shows an experiment on how an adaptive hypermedia course was used to help teachers design their own adaptive courses – and has therefore a high hands-on flavour. It targets questions 2, 3 and 4, and themes 1, 3, 6, 9, 12, 13 and 14. It is useful for practitioners to have a clearer idea of how such authoring for adaptive learning environments could be performed in a real setting. The novelty consists in adapting not only to the students' needs, but also to the teachers' or course designers' needs.
- 7 'Specifying documents in an adaptive hypermedia generation environment: an authoring tool prototype' (Lu and Paris, 2007) – This paper presents an experiment about authoring of adaptive material with the help of graphical tools. As such, it pursues questions 1, 2 and 4, and themes 1, 2, 3, 5, 6, 8 and 12. It specifically looks into how graphical tools and structural aids can help authors create otherwise difficult to specify discourse operators for adaptive material. Such results are useful for practitioners and implementers alike.

3 Conclusion

In this opening paper we have briefly sketched the topic of the special issue organised, 'Authoring of adaptive and adaptable hypermedia', its relevance, timeliness and research directions. Moreover, we have described in short the papers in this special issue and explained how they were grouped, and how they complement each other, and respond to the initial questions formulated, as well as how they apply to the themes identified.

The main questions targeted were those on adaptation scenarios and authoring patterns, showing a growing body of research in this direction. From the themes, again, design patterns, pedagogic models, generic authoring, reusable adaptation models, authoring personas were predominant, showing a growing interest in particular solutions that alleviate the difficulty of authoring for AEH.

It would be interesting to venture an interpretation about the reason some identified themes were not represented by paper submitted or selected for this special issue, especially related to rich user models and authoring for mobile devices. The editors of the special issue and authors of this opening paper believe that the former is less represented, as richness in user model introduces new levels of complexity, and the latter is not represented at all as research in this direction is still in its early stages. However, we hereby encourage researchers to consider these directions as well and we are sure we are going to read their interesting papers at following editions of the workshop series on Authoring Adaptive and Adaptable Hypermedia.

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