

# Future Perspective on Content Design Standards for Technology Enhanced Learning

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## Abstract

*A survey on recent shared technologies and content such as Weblogs, RSS technologies will be carried to propose a new “learning to learn” strategies and methods in content design for both content providers, users and the ones who are both. By the survey on new delivery methods and technologies, it will be demonstrated how the-static-to-dynamic continuum of content development and technology is evolving.*

**Keywords:** Dynamic, Static, Narrow, Learning Systems

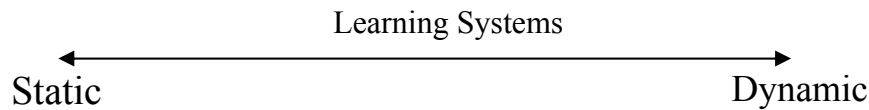
## I. INTRODUCTION

### I.1. Traditional e-Learning versus New Trends

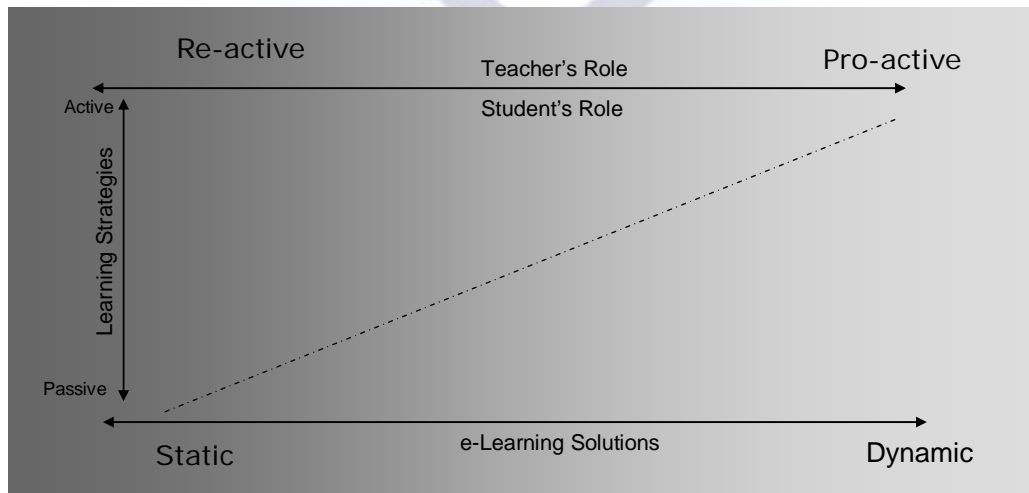
To grasp the problem definition for the future content design standards and enhanced learning technologies to solve, we need to examine today's enhanced learning technologies. A good place to start to focus is in exploring the approach to e-learning that rests on static e- learning content. Think of a typical scenario: e-learning courses are developed using stand-alone desktop authoring tools that encapsulates the knowledge into black boxes that is costly to re-generate, modify, or re-use (even copy/paste will not work) and most of the time is untouchable; i.e. users, both teacher and student, would require prohibitive amount of time to modify content. In the last ten years, an object-based approach to content delivery and development has made much improvement in simplifying content management and provides for more efficient, error-free content revision for developers. Yet the barrier is still present for users. This limits the pedagogical outcomes. We will address these limitations in the following paragraphs.

Even with huge investments by industry and policy making groups in the world, on content and enhanced learning technologies, the struggle remains. On one side there are commercial content and learning technology producers who are fighting to keep electronic content and technologies a paid commodity. On the other side are those who believe that content and technologies is made to be shared, and that doing so benefits everyone. This invites a comfortable-to-understand but yet over-generalized statement, such as: There are two groups of enhanced learning technologies and content. One is more-professionally produced (having the feel of high technology, rich-media components), but contains mostly untouchable or hard-to-touch black boxes. The other is mostly-user (teacher and student)-produced (has shared technology, less media components, is not-professionally tailored), but does not contain any black boxes and uses open technologies. This group heavily gets support from the open-collaborative technologies and entities who provides free-licensing.

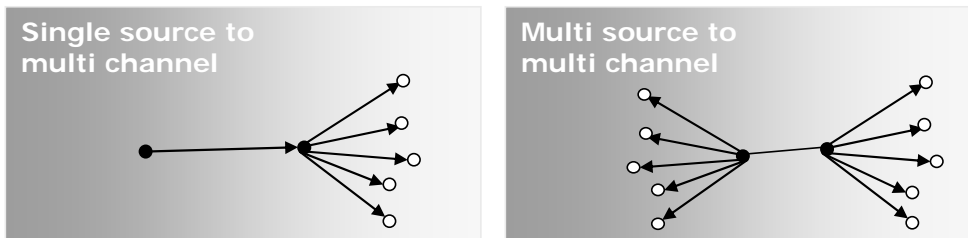
Therefore we can observe two tendencies in the market pulling in opposite directions. There is a need of an approach to melt these tendencies in a continuum of solutions. For the purpose of labelling throughout this document, let's name this continuum as the static-to-dynamic solution.



The word dynamic has two meanings in this context. According to the Webster Dictionary, the first meaning is “marked by usually continuous and productive activity or change”, while another meaning is “of random-access memory: requiring periodic refreshment of change in order to retain data.” So the terms such as “dynamic learning environment” or “dynamically generated content” may be understood in wide and narrow meanings. In the narrow sense; a system (with fixed “adaptive rule sets”) which refreshes the data (content, the user data ... etc.) periodically to adapt to student’s and teacher’s needs, according to underlying pedagogical strategies and approaches. Here, the content is available in very wide range of all possible user data, but all is predefined. In wider sense: a system (with dynamic “adaptive rule sets”) which refreshes the data (content, the user data... etc.) periodically to adapt to student’s and teacher’s needs, but at the same time, allows users to dynamically (on the-run and collaboratively) generate and modify these generated data (content, the user data... etc.). Here, the content and rule sets are not necessarily pre-defined; they can be defined on the run by users (teachers or students) as a part of the learning activity.



On top of these paradigms, there is another dimension which has a high influence on how user interacts with each other and system. That is the modes of “publishing channels.” In the continuum towards static paradigm, the model of a publishing channel is more single-source-to-multi-channel, whereas the collaborative tools allow multi-source-to-multi-channel communication.



We observe that as the tendency goes towards static paradigm, the interaction mode tends towards single-source-to-multi-channel which positions the collaborative tool as an additional tool attached to the learning process. As the tendency goes towards dynamic paradigm, even in the narrow sense, the learning process becomes inclusive to collaborative content development of users in all possible natures (synchronized or asynchronous). But, the shared or modified content most often does not contain rich media elements, or if it has such elements, the content is not collaboratively generated, especially in K-12 education.

### I.2. A Brief Look into Enhanced Learning Trends

European Commission has published for year 2007 the staff working paper Progress Towards The Lisbon Objectives in Education and Training. The report is based on sixteen core indicators for monitoring progress towards the Lisbon Objectives in education and training. Among various skills, such as language, ICT and civic skills, is also listed the important item “learning to learn skills”.

In recent years, the envisioned framework of learning has moved to personalized, self-regulated nature and education is envisioned not “to transform the minds in pre-defined formats,” but rather “to mentor, facilitate learners to achieve the goals that they have projected.” One author has defined learning to be a human process of change that occurs as a result of the interaction of the individual with his or her environment. The change results from the acquiring of knowledge through study, instruction, and experience. Learning further define the distinctions concerning the context of learning, the nature and meaningfulness of knowledge, and the attributes of the learner him- or herself.

Meaningful learning, as opposed to one-for-all structured (one uniform) learning, depends on the concepts, or frames, that are present in the learner’s cognitive structure. For learning to occur, each person’s mental structures require the understanding of that person’s

- past history ,
- present needs,
- an understanding of how he learns to learn in different contexts.

There are similar models for meaningful learning, but all have one thing in one common. In learning process, there is a need of continuous sense-making (not only meaning making but also feeling making) .

In recent years, most schools have come to apply mono curriculum-based education. In academic and some policy maker circles, such a curriculum is considered to be part of the industrial-age vision where schools are like factories and learning outcomes in curriculum are like standards for production.

In the static-to-dynamic continuum of e-learning solutions, the static and single-source-to-multi-channel paradigm can not escape to be incomplete for the above vision; even it attempts to have adaptive nature by pre-defined rule sets with pre-defined learner's contextual parameters.

## II. STATIC AND NARROW SENSE DYNAMIC LEARNING SYSTEMS

### II.1. Static Learning Systems

Over the years, the learning technologies have been changed from the concept of computer based learning towards computer aided (or supported) learning. Even the change in the perceptions have not been completed, one may say that the main stand point still remains. That is, to facilitate learner via a system where learners are having the role of “consumer of the content”, and most possibly teachers having the role of “controller” and the content is the “material” to consume. In early 1990s, the learning systems, especially in adult learning (these systems still were not popular in K-12), the Learning Management Systems (LMSs) have a very structured nature of user types and content. In these systems, the usage scenarios of such systems with the learner creating content was not favoured. The ambition with these systems was to store the content, manage user monitoring data and report on the usage, completion of chunk of “content”. We can give examples of these types of Learning Management Systems such as IBM Learning Space, early Moodle version, any many other Learning Management Systems.

Later LMSs have included also content management systems, so some of them have more extended names such as Learning Content Management Systems (LCMSs). Such systems are offered in the vision that the “teachers” and administrators have the need of controlling the content and system, but not just the system. So in late 1990s and early 2000s there are many systems and content where let the teachers make modifications within the system and content. Nevertheless, the paradigm was kept untouched. The learners are still perceived as consumers, or customers of the system and the content.

Meanwhile, the distance learning using such systems generally started to fail, unless the motivations of the users are kept by synchronised teaching or collaborative supports. But even such attempts, the success was hard to achieve. In most of publishes, the problems are listed as<sup>1</sup>:

- Lack of management oversight
- Lack of motivation
- Problems with technology
- Lack of student support
- Individual learning preferences

- Poorly designed courses
- Substandard/inexperienced instructors

On the other hand, there was a movement on personalisation in pedagogy both in classical teaching and e-learning. On the trace of “learning styles”, “cognitive styles”, there were changes in classical teaching towards “differentiated instruction”. Even, differentiated instruction is not a new phenomenon in education, the wide application started in some countries such as England in late 1900s. The one-room schoolhouses of the past found a way to meet the needs of students working in a wide range of abilities. This approach to differentiating has been shaped by the growing research on learning – drawing on the best practices from special education, gifted education, and multi-age classrooms, as well as recent research on the brain and multiple intelligences. So the reflection of such movement to technology enhanced learning systems was research on personalisation. The lack of motivation was related to lack of personalisation. These researches raised the attention towards Intelligent Tutoring Systems (ITSs).

## II.2. Narrow Sense Learning Systems

Intelligent Tutoring Systems (ITSs) are computer-based instructional systems with models of instructional content that specify what to teach, and teaching strategies that specify how to teach (Wenger 1987, Ohlsson 1987). They make inferences about a student’s mastery of topics or tasks in order to dynamically adapt the content or style of instruction. Content models (or knowledge bases, or expert systems, or simulations) give ITSs depth so that students can “learn by doing” in realistic and meaningful contexts. Models allow for content to be generated “on the fly.” ITSs allow “mixed-initiative” tutorial interactions, where students can ask questions and have more control over their learning. Instructional models allow the computer tutor to more closely approach the benefits of individualized instruction by a competent pedagogue. ITSs have moved out of the lab and into classrooms and workplaces where some have been shown to be highly effective.<sup>2</sup> While intelligent tutors are becoming more common and proving to be increasingly effective they are difficult and expensive to build. Authoring systems are commercially available for traditional computer aided instruction (CAI) and multimedia-based training, but these authoring systems lack the sophistication required to build intelligent tutors. Commercial multimedia authoring systems excel in giving the instructional designer tools to produce visually appealing and interactive screens, but behind the screens is a shallow representation of content and pedagogy. Researchers have been investigating ITS authoring tools almost since the beginning of ITS research, and over two dozen very diverse authoring systems have been built.

Over two dozen ITS authoring systems have been built (not all of the designers of these systems would describe their systems as being “ITS authoring systems.” But computer-based instruction authoring systems that use AI representation techniques such as rules and semantic networks, and those that include models of content and/or teaching strategies may be considered also ITSs.) They differ by the types of domains and tasks they are suited for, by the degree to which they make authoring more easy or efficient, and by the depth and fidelity employed to represent the knowledge or skill being taught. These systems seem to populate the space of authoring tool features almost uniformly, making it difficult to cluster them into discrete groups in an effort to summarize the field. Since

the field is still in early stages, it is intended to help to envision the next generation of authoring tools, rather than to select an existing one to use.

	Category	Example Systems
1	Curriculum Sequencing and Planning	DOCENT, IDE, ISD Expert, Expert CML
2	Tutoring Strategies	Eon, GTE, REDEEM
3	Device Simulation and Equipment Training	DIAG, RIDES, SIMQUEST, XAIDA
4	Domain Expert System	Demonstr8, D3 Trainer, Training Express
5	Multiple Knowledge Types	CREAM-Tools, DNA, ID-Expert, IRIS, XAIDA
6	Special Purpose	IDLE-Tool/IMap, LAT
7	Intelligent/adaptive Hypermedia	CALAT, GETMAS, InterBook, MetaLinks

**Table 1: ITS Authoring Tools by Category**

Early ITS authoring systems fell into two broad categories: those geared toward device simulation and embodying a "learning environments" instructional metaphor, and those based on a traditional curriculum (or courseware) metaphor. Even though some recent systems combine aspects of both perspectives, the majority of authoring tools fall similarly into two broad categories: pedagogy-oriented and performance-oriented<sup>3</sup>. Pedagogy oriented systems (categories 1, 2, 5, and 7 in Table 1) focus on how to sequence and teach relatively canned content. Performance-oriented systems (categories 3, 4, and 6 in Table 1) focus on providing rich learning environments in which students can learn skills by practicing them and receiving feedback.

### III. CONCLUSION

Meaningful learning, as opposed to one-for-all structured (one uniform) learning, depends on the concepts, or frames, that are present in the learner's cognitive structure. For learning to occur, each person's mental structures require the understanding of that person's

- past history ,
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In academic and some policy maker circles, mono-curriculum is considered to be part of the industrial-age vision where schools are like factories and learning outcomes in curriculum are like standards for production.

In the static-to-dynamic continuum of e-learning solutions, the static and single-source-to-multi-channel paradigm can not escape to be incomplete for the above vision; even it attempts to have adaptive nature by pre-defined rule sets with pre-defined learner's contextual parameters. There is a need for further research and development of e-learning

solutions and content (considering also curriculum as a content structure) and developing standards for adaptive and intuitive learning systems that is in a multi-source to multi-channel dynamic (in wider sense) paradigm.

## APPENDIX

Below is a table of the ITS authoring tools discussed in this paper, with selected references for each.

1. CALAT (& CAIRNEY)

Kiyama, M., Ishiuchi, S., Ikeda, K., Tsujimoto, M. & Fukuhara, Y. (1997). Authoring Methods for the Web-Based Intelligent CAI System CALAT and its Application to Telecommunications Service. In the Proceedings of AAAI-97, Providence, RI.

2. CREAM-TOOLS

Frasson, C., Nkambou, R., Gauthier, G., Rouane, K. (1998). An authoring model and tools for curriculum development in intelligent tutoring systems. Nkambou, R., Gauthier, R., & Frasson, M.C. (1996). CREAM-Tools: an authoring environment for curriculum and course building in an ITS. In Proceedings of the Third International Conference on Computer Aided Learning and Instructional Science and Engineering. New York: Springer-Verlag.

3. D3-TRAINER

Reinhardt, B., Schewe, S. (1995). A shell for intelligent tutoring systems. In J. Greer(Ed) Proc. of the Int. Conf. on AI in Education. AACE: Charlottesville, VA, 1995.

4. DEMONSTR8 (&TDK, PUPS)

Blessing, S.B. (1997). A programming by demonstration authoring tool for model tracing tutors. Int. J. of Artificial Intelligence in Education. Vol. 8, No. 3-4, pp 233-261.

Anderson, J. R. & Pelletier, R. (1991). A development system for model tracing tutors. In Proc. of the International Conference on the Learning Sciences, Evanston, IL, 1-8.

Anderson, J. & Skwarecki, E. (1986). The Automated Tutoring of Introductory Computer Programming. Communications of the ACM, Vol. 29 No. 9. pp. 842-849

5. DIAG

Towne, D.M. (1997). Approximate reasoning techniques for intelligent diagnostic instruction. International J. of Artificial Intelligence in Education. Vol. 8, No. 3-4, pp. 262-283

6. DNA

Shute, V.J. (1998). DNA - Uncorking the bottleneck in knowledge elicitation and organization. Proceedings of ITS-98, San Antonio, TX, pp. 146-155.

7. DOCENT (& Study)

Winne P.H. (1991). Project DOCENT: Design for a Teacher's Consultant. In Goodyear (Ed.), Teaching Knowledge and Intelligent Tutoring. Norwood, NJ: Ablex.

Winne, P. & Kramer, L. (1988). "Representing and Inferencing with Knowledge about Teaching: DOCENT." Proceedings of ITS-88. June 1988, Montreal, Canada.

8. EON (& KAFITS)
 

Murray, T. (1998). Authoring knowledge-based tutors: Tools for content, instructional strategy, student model, and interface design. *J. of the Learning Sciences*, Vol. 7. No. 1.

Murray, T. (1996). Special Purpose Ontologies and the Representation of Pedagogical Knowledge. In *Proceedings of the International Conference on the Learning Sciences, (ICLS-96)*, Evanston, IL, 1996. Charlottesville, VA: AACE.

Murray, T. & Woolf, B. (1992). Results of Encoding Knowledge with Tutor Construction Tools. *Proceedings of AAAI-92*. San Jose, CA., July, 1992.
9. EXPERT-CML
 

Jones, M. & Wipond, K. (1991). Intelligent Environments for Curriculum and Course Development. In Goodyear (Ed.), *Teaching Knowledge and Intelligent Tutoring*. Norwood, NJ: Ablex.
10. GETMAS
 

Wong, W.K. & Chan, T.W. (1997). A Multimedia authoring system for crafting topic hierarchy, learning strategies, and intelligent models. *International J. of Artificial Intelligence in Education*, Vol. 8, No 1, pp. 71-96.
11. GTE
 

Van Marcke, K. (1998). GTE: An epistemological approach to instructional modeling. *Instructional Science*, Vol. 26, pp 147-191.

Van Marcke, K. (1992). Instructional Expertise. In Frasson, C., Gauthier, G., & McCalla, G.I. (Eds.) *Proc. of Intelligent Tutoring Systems '92*. New York: Springer-Verlag.
12. ID EXPERT (& Electronic Trainer, ISD-Expert)
 

Merrill, M.D., & ID2 Research Group (1998). ID Expert: A Second generation instructional development system. *Instructional Science*, Vol. 26, pp. 243-262.

Merrill, M. D. (1989). An Instructional Design Expert System. *Computer-Based Instruction*, Vol. 16 No. 3, 95-101.

Merrill, M. D. (1987). "An Expert System for Instructional Design." *IEEE Expert*, Summer 1987, pg. 25-37.

Merrill, M. D. & Li, Z. (1989). "An Instructional Design Expert Sys-tem." *Journal of Computer-Based Instruction*, Vol. 16, No.3,pg. 95-101.
13. IDE (& IDE Interpreter)
 

Russell, D. (1988). "IDE: The Interpreter." In Psotka, Massey, & Mutter (Eds.), *Intelligent Tutoring Systems, Lessons Learned*. Hillsdale, NJ: Lawrence Erlbaum.

Russell, D., Moran, T. & Jordan, D. (1988). The Instructional Design Environment. In Psotka, Massey, & Mutter (Eds.), *Intelligent Tutoring Systems, Lessons Learned*. Hillsdale, NJ: Lawrence Erlbaum.
14. IDLE-Tool (& IMAP, INDIE, GBSarchitectures)
 

Bell, B. (1999). Supporting educational software design with knowledge-rich tools. *Int. J. of Artificial Intelligence in Education*.

- Bell, B. (1998). Investigate and decide learning environments: Specializing task models for authoring tools design. *J. of the Learning Sciences*, Vol. 7. No. 1.
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- Brusilovsky, P., Schwartz, E., & Weber, G. (1996). A Tool for Developing Adaptive Electronic Textbooks on WWW. *Proc. of WebNet-96, AACE*.
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15. IRIS A  
 rruarte, A., Fernandez-Castro, I., Ferrero, B. & Greer, J. (1997). The IRIS shell: How to build ITSs from pedagogical and design requisites. *International J. of Artificial Intelligence in Education*. Vol. 8 , No. 3-4, pp. 341-381.
16. LAT (LEAP Authoring Tool)  
 Sparks, R. Dooley, S., Meiskey, L. & Blumenthal, R. (1999). The LEAP authoring tool: supporting complex courseware authoring through reuse, rapid prototyping, and interactive visualizations. *Int. J. of Artificial Intelligence in Education* (this issue).  
 Dooley, S., Meiskey, L., Blumenthal, R., & Sparks, R. (1995). Developing reusable intelligent tutoring system shells. In *AIED-95 workshop papers for Authoring Shells for Intelligent Tutoring Systems*. MetaLinks Murray, T., Condit, C., & Haaugsjaa, E. (1998). *MetaLinks: A Preliminary Framework for Concept-based Adaptive Hypermedia*. Workshop Proceedings from ITS-98 WWW-Based Tutoring Workshop., San Antonio, Texas, 1998.
17. REDEEM (& COCA)  
 Major, N., Ainsworth, S. & Wood, D. (1997). REDEEM: Exploiting symbiosis between psychology and authoring environments. *International J. of Artificial Intelligence in Education*. Vol. 8 , No. 3-4, pp. 317-340.  
 Major, N. (1995). Modeling Teaching Strategies. *J. of AI in Education*, 6(2/3), pp.117-152.  
 Major, N.P. & Reichgelt, H (1992). COCA - A shell for intelligent tutoring systems. In Frasson, C., Gauthier, G., & McCalla, G.I. (Eds.) *Procs. of Intelligent Tutoring Systems '92*. New York: Springer-Verlag.
18. RIDES (& IMTS, RAPIDS, and see DIAG)  
 Munro, A., Johnson, M.C., Pizzini, Q.A., Surmon, D.S., Towne, D.M., & Wogulis, J.L. (1997). Authoring simulation-centered tutors with RIDES. *International J. of Artificial Intelligence in Education*. Vol. 8 , No. 3-4, pp. 284-316.

Towne, D.M., Munro, A., (1988). The Intelligent Maintenance Training System. In Psotka, Massey, & Mutter (Eds.), *Intelligent Tutoring Systems, Lessons Learned*. Hillsdale, NJ: Lawrence Erlbaum. *Authoring Intelligent Tutoring Systems: An Analysis of the State of the Art*

19. SIMQUEST (& SMISLE)

Jong, T. de & vanJoolingen, W.R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research*, Vol. 68 No.2, pp. 179-201.

Van Joolingen, W.R. & Jong, T. de (1996). Design and implementation of simulationbased discovery environments: The SMISLE solution. *Int. J. of Artificial Intelligence in Education* 7(3/4). pp. 253-276.

20. TRAINING EXPRESS

Clancey, W. & Joerger, K. (1988). "A Practical Authoring Shell for Apprenticeship Learning." *Proceedings of ITS-88*, 67-74. June 1988, Montreal.

XAIDA

Hsieh, P., Halff, H, Redfield, C. (1999). Four easy pieces: Developing systems for knowledge-based generative instruction. *Int. J. of Artificial Intelligence in Education*.

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Redfield, C.L., (1996). "Demonstration of the experimental advanced instructional design advisor." In the *Third International Conference on Intelligent Tutoring Systems*, Montreal, Quebec, Canada, June 12-14, 1996

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<sup>1</sup> Computerworld, 10/8/2001, Vol. 35 Issue 41, p30, 2p, 1c

<sup>2</sup> Shute, V.J. and Regian, J.W. (1990). *Rose Garden Promises of Intelligent Tutoring Systems: Blossom or Thorn?* Presented at Space Operations, Automation and Robotics Conference, June 1990, Albuquerque, NM.

<sup>3</sup> Murray, T. (1997) Expanding the knowledge acquisition bottleneck for intelligent tutoring systems. *International J. of Artificial Intelligence in Education*. Vol. 8 , No. 3-4, pp. 222- 232.

<sup>4</sup> Murray, T. (1999) *Authoring Intelligent Tutoring Systems: An Analysis of the State of the Art*. *International Journal of Artificial Intelligence in Education* (1999), 10, 98-129