Creating Contents based on Inter-play Between the Ontologies of Content's Key Segments and Problem Context

Kambiz Badie[1], Mahmood Kharrat[1], Maryam Tayefeh Mahmoudi[1,2], Maryam S. Mirian[1,2],
Sogol Babazadeh[1], Tahereh Mirsaeed Ghazi[1]

1: Knowledge Engineering & Intelligent Systems Group
Iran Telecom Research Center
Tehran, Iran
Emails: {k_badie, Kharrat, Mahmodi, mirian, s_babazadeh, a_ghazi}@itrc.ac.ir
2: Department of Electrical and Computer Eng.,
Faculty of Engineering, University of Tehran
Tehran, Iran

Abstract— An approach is presented to show how contents can be created through an inter-play between the ontology of their key segments and the ontology of problem context using the knowledge on some nominal values which stand for the way linguistically-significant notions are tackled. The approach seems to be suitable for any kind of organizational task for which these nominal values can be defined in a reasonable way.

Keywords-content creation; ontology; organizational task; key segment; problem task; linguistically- significant notion

I. INTRODUCTION

Creating contents is of major significance to those involved in tasks such as planning, research, innovation, development and learning in organizations. Regarding this, the main aim of content creation is to supply appropriate contents based on which users can receive adequate information to do their tasks in a reasonable manner. A variety of approaches have been proposed for content creation among which approaches based on mining, ontology-based reasoning, deductive/rule-based reasoning, analogical/ case-based reasoning, and fusion/blending/composition are of particular significance. In all these approaches, it is somewhat important to project the requirements of a task and the related context onto the way the key segments in the content are to be formed. Ontologies, as powerful means for representing knowledge, have been shown to be helpful in this regard. In this paper, based on the above point, a framework is proposed for creating contents in organizations, which is based on a kind of inter-play between the essential ontologies. In this regard, each key segment is associated with a nominal value, according to which a petit content is created using a number of linguistically significant notions. The status of a nominal value is decided by the type of the task, for which a content is to be created. The ontology of problem context is employed in this regard. In this paper, having overviewed the existing approaches to content creation, the ontologies mentioned above together with the interplay between these ontologies will be discussed. Subsequently, an example will be presented showing how a research proposal as content can be created using the proposed approach.

II. OVERVIEW OF THE EXISTING APPROACHES TO CREATING CONTEXTS FOR DECISION SUPPORT IN ORGANIZATIONS

The existing approaches to creating contents for organizational purposes can be categorized into the four groups as follows:

• Mining and Ontology-based Reasoning:

According to this approach, user's required content is derived by mining the available databases of organizational documents/contents[1]. The most common usage of this approach is semantic web[2]even for developing learning contents based on ontology technology [3]and supporting query-based systems[4][4]. Moreover, mining and ontology-based reasoning is widely used in different applications such as: reusing content for adaptive web information systems[5], generating adaptive courses[6], supporting adaptive navigation in educational hypermedia [7], managing ontology-based e-learning content[8], sharing ontology-based multimedia for paper generation[9], and finally applying data mining techniques to e-learning problems[10] .

• Deductive/ Rule-Based Reasoning:

According to this approach, organizing the content is based on a process of deductive reasoning, which can be realized through query-based systems. Some of the existing systems based on this approach can be mentioned as follows: aggregation in the generation of argumentative texts[11],multi-agent story generation[12], integrating discourse for document drafting[13], personalizing user-generated content in mobile networks permitting the users to actively cooperate in tasks of generation, annotation and classification of digital contents [14] , and supporting the generation of isomorphic tutoring content using rule-based system[15] and organizing texts based on projection from researcher space onto text space [16,17].

IEEE computer society

• Analogical/ Case-Based Reasoning:

According to this approach, and based on some previously stored experiences, current situation is compared with some similar cases which are available in case library and appropriate solution is then derived from the combination of the related solutions [18].This can be applied to education or planning issues [19], improving adaptive navigation with case-based reasoning[20],story plot generation based on CBR [21],knowledge intensive template selection using CBR[22], interactive drama system for generating stories[23],and finally data mining based on CBR for e-learning purposes[10].

• Blending/ Fusion/ Composition:

According to this approach, a variety of alternatives are blended, fused or composed together to yield the final content. Conceptual integration and blending that is mostly used in creative story generation [24,25] is the prime choice in this regard. Dynamic web content generation[26] and automatic story telling[27] systems can also be mentioned as the examples for fusion approach.

Concept composition can also be numerated as an alternative approach to creating contents based on composition [28,29].

III. THE PROPOSED APPROACH TO CONSIDERING ONTOLOGIES FOR CONTENT'S KEY SEGMENTS AND PROBLEM CONTEXT

A. Ontology for Content's Key Segments

The ontology for content's key segments is illustrated in Figure1. As it is seen from the figure, labels such as "general background", "existing viewpoints", "key issue", "realization/ implementation", "comparative analysis & capability interpretation" and "conclusion & prospect anticipation" have been realized to be consistent for a wide range of contents which are to be created for helping users with their tasks in organizations. It is interesting to see that these segments are equally being used by a wide range of knowledge workers (researchers, innovators, developers, planners, analyzers, …) in an organization to disseminate results of their works in terms of appropriate contents. An overview of the tasks nature from a cognitive viewpoint, in addition to the above fact, take us to the point that these key segments would be sufficient as the alternatives for the upper layers of the proposed ontology. The major relations in this ontology are "is-a" for the first layer, and "has-a" for the second layer.
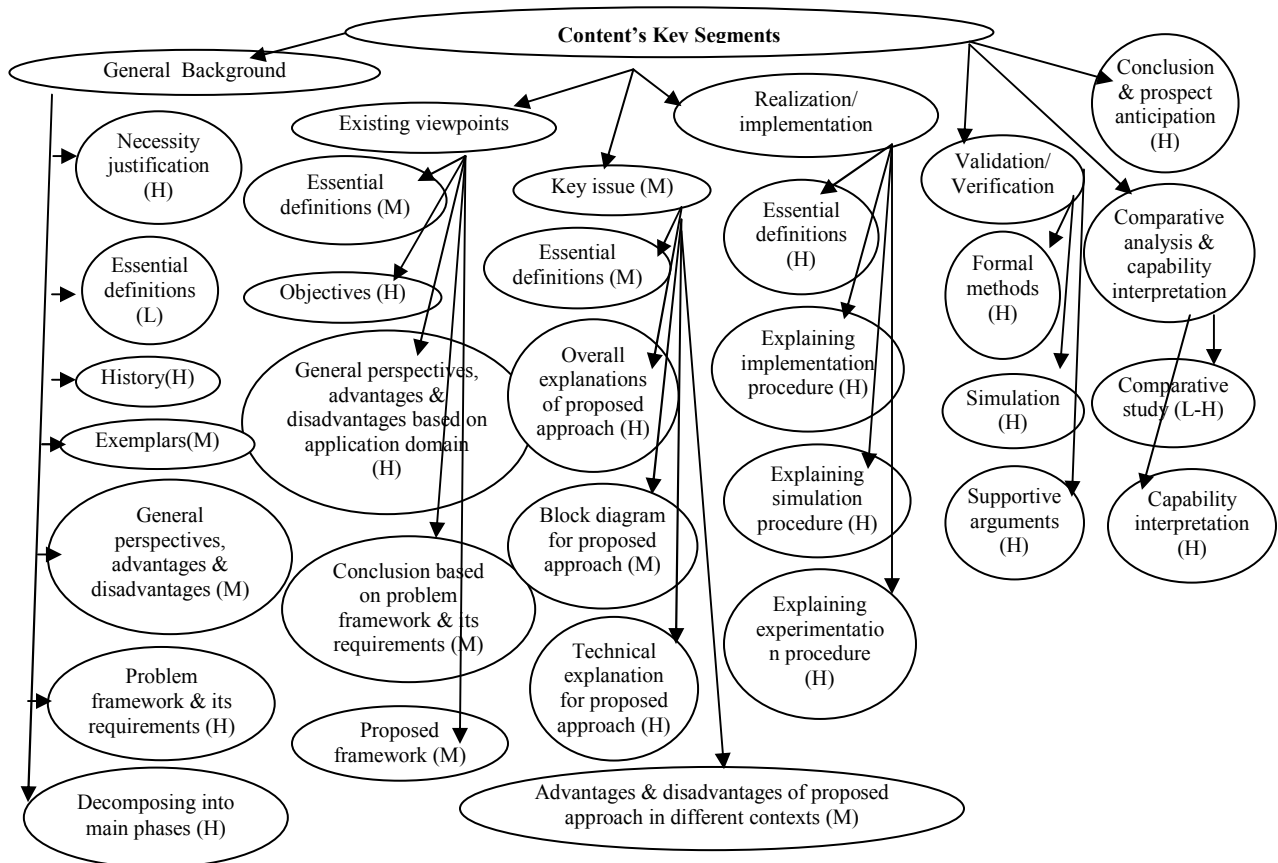

Figure 1. The ontology of Content's Key Segments

Obviously, based on the type of a task, a limited number of the labels and the corresponding sub-labels may be activated. Nominal values "L" (standing for Low), "M"(standing for Medium), and "H" (standing for High) associated with the labels of key segments indicate the extent according to which linguistically significant notions such as

B. Task Categories

Some of the major tasks important for an organization are illustrated in Table1 together with their motivation for content creation. The ground for selecting such items is the analytic and synthetic needs for organizational decision making, which have appeared well in the form of appropriate departments or units in many advanced organizations.

TABLE1. MAJOR TASK CATEGORIES AND THEIR MOTIVATIONS FOR CREATING CONTENT

Type of Task	Motivation
Planning/ Scheduling	Helping the user do planning through encapsulating the essential requirements for planning in the content.
Research	Helping the user do research through encapsulating the essential requirements for research in the content
Innovation	Helping the user do innovation through encapsulating the essential requirements for innovation in the content
Development/ optimization/ Improvement	Helping the user do development through encapsulating the essential requirements for development in the content
Education/ Promotion	Helping the user do education through encapsulating the essential requirements for education in the content
Analysis/ Assessment/ Assurance	Helping the user do analysis through encapsulating the essential requirements for analysis in the content.
Guidance	Helping the user do guidance through encapsulating the essential requirements for guidance in the content
Justification	Helping the user do justification through encapsulating the requirements for justification in the content

C. Ontology for Problem Context

By the problem context, we mean the conditions under which a task is to be performed by a content's user. Taking this point into account, problem context can be considered from the viewpoints of i) focal entities ruling over the problem and ii) constraints which limit the scope of applying these focal entities with respect to the possible problems. With regard to the ontology of focal entities, we are mostly concerned with the three categories of "content-ware", "human-ware", and "techno-ware", which are the basic necessities for an organization. Obviously, each of these categories holds its own ontology from the standpoint of certain aspects. For instance, category of "content-ware" addresses the "possible tasks and their types", while category of "human-ware" tackles issues such as "roles" and "beneficiaries". Also category of "techno-ware" includes issues such as "specifications", "standards & benchmarks", "models & algorithms", etc (Figure 2). The entities under the nodes "human-ware", "techno-ware", and "content-ware" have been determined according to the general knowledge which exists with regard to respectively, the positions according to which humans tend to contents to help them achieve their tasks, technological entities with respect to the

"What", "Who", "Whom", "Where", "Which", "When", "How", and "Why", can be addressed to create a petit content for each key segment. The nominal values associated with the corresponding nodes in the ontology, belong to the case of "research" as an organizational task.

main issues that make sense to the process of task achievement, and finally the task categories themselves.

Also, with regard to the ontology of constraints, we are primarily concerned with the existing limitations/ restrictions with respect to issues such as time, space, energy, and resources, users,… that are essential to performing a task.

D. Interplay between the Ontoloigies of Content's Key Segments and Problem Context

As discussed before, the interplay between a content's key segments and a problem context leads to the point where some petit contents can be created for the corresponding key segments. This is done by the nominal values pre-agreed for each task, to show to what extent linguistically significant notions like "What", "Which", "Where", "When", "Whom", "Who", "Why", and "How" should be addressed. Handling these notions calls for a consideration of the problem context with respect to the basic factors of content-ware, human-ware, and techno-ware. Table2 indicates the status of the nominal values L, M, and H with regard to the corresponding linguistically – significant notions. As is seen from the figure, the higher a nominal value, a higher expectation would exist with regard to the depth of linguistically significant notions. Let say, comparing "M" to "L", the linguistically significant notion "How" is also called for. Also, comparing "H" to "M", notion "Why", which stands for a deeper explanation in the petit content, should be added.

TABLE2. STATUS OF THE NOMINAL VALUES

Nominal Value	Status of Linguistically Significant notions
L (Low)	Addresses What, Which, Where, When, Who , and Whom
M (Medium)	Addresses What, Which, Where, When, Who, Whom, and How
H (High)	Addresses What, Which, Where, When, Who, Whom, How, and Why

IV. AN EXAMPLE FOR GENERATING A RESEARCH PROPOSAL AS A CONTENT

To show the capability of the proposed approach to content creation, let consider a case where a content is to be created for a user whose aim is to do research within a certain scope in the area of e-learning. Taking this point into account, this content should be adjusted such that the user can be helped to make a reasonable approach to his/her steps in research. Coming to the discussion of III-D, each key segment in the content should be accompanied with an appropriate nominal value which itself stands for a reasonable tackling regarding the linguistically significant notions already discussed. Our example is to create a content which can guide the researcher to a forum wherein he/she can develop a framework for adapting an e-content to

learner's conditions/requirements in e-learning environment. Regarding this example, we consider segments such as "Motivation", "Historical Background", "Research Objectives & Scopes", "Major Phases", "Capability Assessment", "Prospect Anticipation" ,as illustrated in Table3. These segments have been shown to be meaningful with regard to the task of "research", taking into account aspects like research motivation, history of performed activities, research's objectives & scope, required phases in research, assessing the capability of the research's outcome, as well as anticipating the prospects of the corresponding research. The column at the extreme right of the table indicates the key segments (III-A) according to which the corresponding research proposal's segments can be structured. The statii of the nominal values in the Table are decided according to the functionality we expect from "research" as a task and the very significance of the related key segments with regard to this expectation. The same fact is consistent for other task categories as well.

Taking the above discussion into account, the petit content created, for instance, with regard to the segment of "motivation" would be as follows:

a. "Motivation"'s Petit Content
 • Definitions (L):
 - What is concerned: The scale of adaptability between content's features and user's conditions/requirements (beliefs, desires, intentions, background,…) in an e-learning domain.
 - By Who: Various characters such as those related to management, sources, evaluation, …
 - for Whom: Stakeholders such as: learning institutes, students, teachers,…
 - on Which: A wide variety of contents such as courseware, curriculum,…

 • Necessity Justification(H):
 - What necessity to be justified : Adaptability between content's features and user's requirements
 - Where : Specially in e-learning domain,
 - Why: Because of an increase in content creation costs, and decrease in user's learning level.
 - How: Using various adaptation methods including: filtering, customization, summarization, classification, enhancement,…

   As it is seen, three categories of "content-ware", "human-ware", and "techno-ware" have been used to structure the explanations for the linguistically significant notions. For instance, the explanation for Who (in Definition) is supported by the category of "human-ware", while the explanation for How (in Necessity Justification) is backed up by the category of "techno-ware", etc.

   Also , for the segment of " Comparative Analysis & Modeling" (in "Major Phases"), the petit content would be as follows:

b. "Comparative Analysis & Modeling"'s Petit Content
- What is concerned: Capabilities and constraints of the existing methods for adaptation including: filtering, customization, summarization, classification, enhancement, …
- How: Using statistical methods for comparative analysis & modeling including simulation and structural methods such as argumentation.
-Why: Because statistical methods can help realize the advantages & disadvantages for the experienced cases , regarding the ongoing problem situation, and argumentation can help validate the priority of a method with respect to certain aspects.

TАBEL3. SEGMENTS FOR THE CONTENT OF RESEARCH PROPOSALS

Research Proposal's Segment	Nominal Value	Key Segment
• **Motivation**		
✓ **Definitions**	L	General Background> Essential definitions
✓ **Necessity Justification**	H	General Background> Necessity Justification
• Historical Background		
✓ Definitions	L	General Background> Essential definitions
✓ Brief History	H	General Background> History
✓ Overview of the Existing Approaches	M	General Background> General perspectives, advantages & disadvantages
✓ Problem's Requirements	H	General Background> Problem framework & its requirements
• Research Objectives & Scopes		
o Statement of the Objectives	H	Existing viewpoints> Objectives
o Basic Definitions & Terminologies	M	Existing viewpoints> Essential definitions
o Research Audiences/Users	H	General Background> Problem framework & its requirements
o Research Logical Scope	H	General Background> Problem framework & its requirements
o Basic Methodology and/or tools	H	Existing viewpoints> Objectives
o Technical Platforms & Specifications	H	Proposed approach realization/ implementation> Essential resources
o Research Constraints	H	General Background> Problem framework & its requirements
• **Major Phases**		
o **Decomposing into main stages** (output: main stages)	H	General Background> Decomposing into main phases
o Literature Survey (output: relevant contents)	H	General Background> History

629

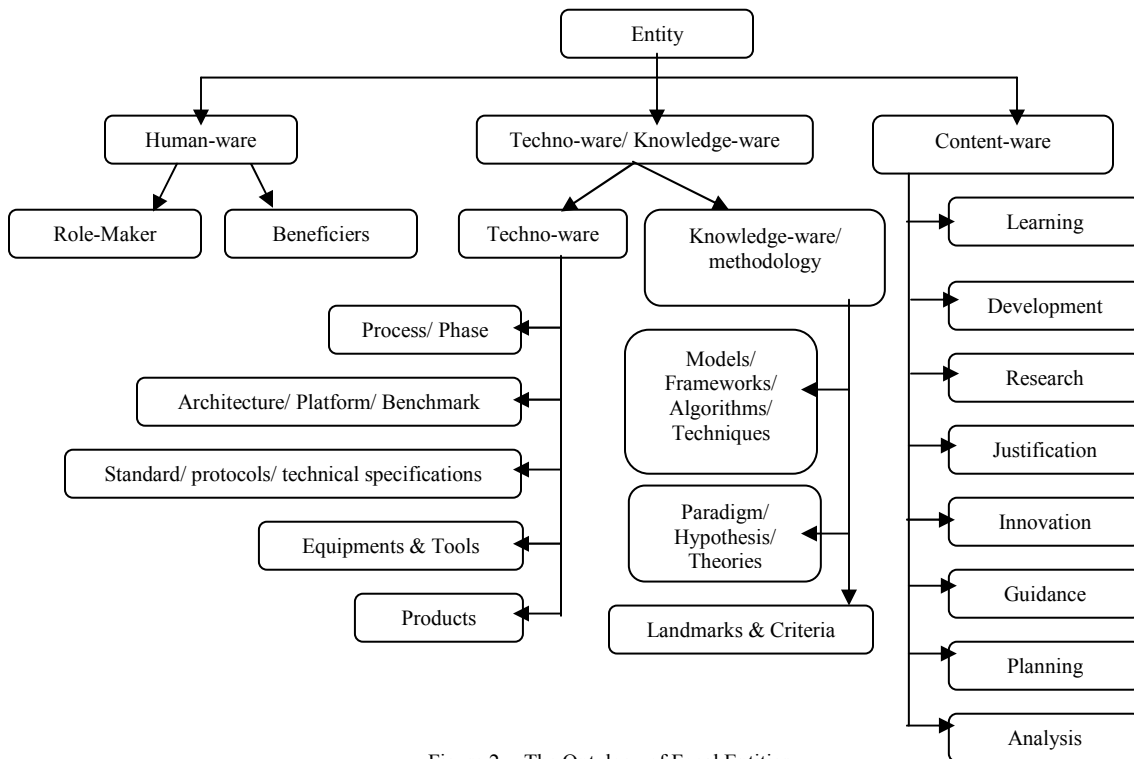|		
o Purpose-Oriented Processing (output: key methods/frameworks)	H	Key issue> Overall explanations of proposed approach
o **Comparative Analysis & Modeling** (output: advantages & disadvantages)	H	Existing viewpoints> General perspectives, advantages & disadvantages based on application domain
o Methods / Frameworks Proposition (output: method/framework)	H,M	Key issue> Overall explanations of proposed approach, Key issue> Block diagram for proposed approach
o Methods/ Frameworks Application (Realization) (output: result of application)	H,H,H	Proposed approach realization/ implementation> Explaining implementation procedure , Proposed approach realization/ implementation> Explaining simulation procedure, Proposed approach realization/ implementation> Explaining experimentation procedure
o Validation/Verification (output: status of validity/truth)	H,H,H	Validation/Verification> Formal methods, Validation/Verification> Simulation, Validation/Verification> Supportive arguments
• Capability Assessment	L-H	Comparative analysis & capability interpretation
• Prospect Anticipation	H	Conclusion & prospect anticipation

Figure 2.   The Ontology of Focal Entities

It should be noted that, for the moment, it's the human operator who creates a petit content (based on the information belonging to the related linguistically-significant operators and the related information on content-ware, human-ware, and techno-ware. This may however be done in an automatic way, if knowledge on natural language processing is taken into account.

V.   CONCLUDING REMARKS & FURTHER DISCUSSION

An approach was discussed for creating contents to help users with their tasks, based on an inter-play between the ontology of the key segments and the problem context. Regarding such a process, the nominal value associated with each key segment for a certain task is transformed into a petit content using a number of linguistically-significant notions,

which take into account the ontology of problem context from the standpoint of the three categories of human-ware, content-ware, and techno-ware. In this regard, an example was discussed to show how the content of a research proposal can be created making use of the above approach.

For the moment, petit contents for the key segments are created manually based on the maneuver scope of linguistically-significant notions regarding the ontology of problem context. As a future work, such a process can be performed automatically using knowledge of natural language processing and the reasoning techniques in the domain of symbolic artificial intelligence.

REFERENCES

630

[1] O. Bodenreider, and F.Olken, (2007), "Ontology Driven Reasoning", Ontology Summit 2007, NIST, Gaithersburg, Maryland, USA.

[2] A. Kiryakov, (2006), "Ontologies for Knowledge Management, in Semantic Web Technologies: Trends and Research in Ontology-based Systems", John Wiley & Sons, pp. 115-138.

[3] C. Pahl and E. Holohan," Applications of Semantic Web Technology to Support Learning Content Development" , Interdisciplinary Journal of E-Learning and Learning Objects Volume 5, 2009.

[4] C.Tempich, H.S.Pinto, Y.Sure, D.Vrandecic, N.Casellas, and P. Casanovas, .(2005), "Evaluating DILIGENT Ontology Engineering in a Legal Case Study", IVR 22nd World Congress.

[5] S.Iksal, and S. Garlatti, (2004), "Adaptive Web Information Systems: Architecture and Methodology for Reusing Content", EAW'04: Engineering the Adaptive Web, Eindhoven: Technishe Universiteit Eindhoven, pp.36-45.

[6] J.F.Duitama, B. Defude, A. Bouzeghoub, and C.Lecocq, (2003)," A Framework for the Generation of Adaptive Courses based on Semantic Metadata", Proc. of MAWIS Workshop with OOIS'03 Conference, Geneva.

[7] P.Brusilovsky, (2003), "Adaptive navigation support in educational hypermedia: the role of student knowledge level and the case for meta-adaptation", British Journal of Educational Technology, Vol.34, No. 4, pp.487-497.

[8] N.Jekjantuk and M. Hasan, (2007), "E-Learning Content Management: An Ontology-based Approach", Advances in Computer Science and Technology, ACST 2007, Phuket, Thailand.

[9] J. Zhu; H.Chen; B. Zou; H. Zhou, "A Ontology-Based Multimedia Resource Sharing Framework in Multimedia Science Paper Generation",Knowledge Discovery and Data Mining, 2008. WKDD 2008. International Workshop on23-24 Jan. 2008, pp.322 – 325.

[10] F. Castro,A. Vellido,À. Nebot and F. Mugica ," Applying Data Mining Techniques to e-Learning Problems", Studies in Computational Intelligence,Springer,2007, Volume 62, pp.183-221.

[11] A.Fiedler and X.Huang, (1995)," Aggregation in the Generation of Argumentative Texts", In Proc. of the 5th European Workshop on Natural Language Generation (EWNLG), pp.5-9.

[12] M.O.Riedl and R.M. Young, (2004)," An Intent-Driven Planner for Multi-Agent Story Generation", Proc.of the 3rd IEEE Computer Society Intl. Joint Conf. on Autonomous Agents and Multiagent Systems, Washington, DC , pp.186-193.

[13] L.Kranting, C.B. Callaway, B.W. Mott, and J.C..Lester, (1999), "Integrating discourse and domain knowledge for document drafting", Proc. of the 7th Intl. Conf. on Artificial intelligence and law, Norway, pp.214 - 220.

[14] Y. B.Fernández, J. J. Arias, A. Solla, M. R.Cabrer and M. L.Nores , "ZapTV: Personalized User-Generated Content for Handheld Devices in DVB-H Mobile Networks", Lecture Notes in Computer Science ,Springer, Volume 5066/2008,pp. 193-203,2008.

[15] S.Almeida, M.Vartak, and N. Heffernan, (2008) , "Supporting the Generation of Isomorphic Tutoring Content", Intelligent Tutoring System Conference 2008 - Young Researchers Track.

[16] M.T.Mahmoudi, K.Badie, M.Kharrat, "Text organization via projection from Researcher-Space onto text-Space",Kybernetes (The International Journal of Systems,Cybernetics and Management Science),Vol 37,Issue 8,2008.

[17] M.T.Mahmoudi, K.Badie: "An Approach to On-line Text Generation for E-learning Purposes". ITCC (2) 2004, pp. 786-789.

[18] J.L.Kolodner, M.T.Cox, and P.A.Gonzalez, (2006), "Case-based reasoning-inspired approaches to education", Knowledge Engineering Review, Vol.20, No.3, pp.299-303.

[19] H.Avila and R. Bergmann, (2006), "Case-based planning", Engineering Review, Vol. 20, No.3, pp.283-287.

[20] J.M. Heraud, (2004), "Pixed: improving adaptable navigation with Case-Based Reasoning", Proc. of ED-MEDIA'2004, World Conference on Educational Multimedia, Hypermedia and Telecommunications, Switzerland, pp.656-661.

[21] P.Gervás, B.Díaz-Agudo, F.Peinado and R.Hervás, (2004), "Story Plot Generation based on CBR", Journal of Knowledge-Based Systems, Elsevier Science, (Selected papers from 12th Conference on Applications and Innovations in Intelligent Systems), Cambridge, UK

[22] R.Hervás and P.Gervás (2006), "Case-Based Reasoning for Knowledge-Intensive Template Selection During Text Generation", 8th European Conf. on Case-Based Reasoning (ECCBR 06), Turkey, Springer LNAI Series.

[23] Z. Tomaszewski and K. Binsted, "Marlinspike: An Integrated Approach to Interactive Drama", INTEGRATING TECHNOLOGIES FOR INTERACTIVE STORIES , INTETAIN 2008 Workshop, Playa del Carmen, Mexico - 7th January 2008.

[24] G. Fauconnier and M. Turner, "Conceptual Integration Networks", Published in *Cognitive Science*, 22(2) 1998, 133-187.

[25] F. C. Pereira , A. Cardoso," Conceptual Blending and the Quest for the Holy Creative Process", In Proceedings of the 2nd Workshop on Creative Systems: Approaches to Creativity in AI and Cognitive Science, ECAI 2002, Lyon, France, 2002.

[26] J. Ravi, Z. Yu, W. Shi ,"A survey on dynamic Web content generation and delivery techniques" , Published by Elsevier Ltd., Journal of Network and Computer Applications, 2009.

[27] D. Pizzi, M. Cavazza, A. Whittaker and J. Lugrin , "Automatic Generation of Game Level Solutions as Storyboards", Proceedings of the Fourth Artificial Intelligence and Interactive Digital Entertainment Conference, 2008.

[28] M.T.Mahmoudi, K.Badie: "Content Determination for Composite Concepts Via Combining Attributes' Values of Individual Frames". IKE 2004, pp.211-215.

[29] M.T.Mahmoudi, K.Badie, M.Kharrat, S. Babazadeh Khamaneh, M.Yadollahi Khales: "Content Personalization in Organizations via Composing a Source Content Model with User Model". IC-AI 2008, pp.943-949.