Digital Library Curriculum Development:

Enhancing Education and Comprehension of NDLTD

Edward A. Fox, Seungwon Yang,
Barbara M. Wildemuth, Jeffrey Pomerantz

ETD 2006, Quebec Canada

NDLTD Goals

- For Students:
  - **Gain knowledge and skills for the Information Age**
  - **Richer communication (digital information, multimedia, …)**
- For Universities:
  - **Easy way to enter the digital library field and benefit thereby**
- For the World:
  - **Global digital library – large, useful, many services**

Curriculum Development Project

- Collaborative Research launched by:
  - **Department of Computer Science, Virginia Tech**
  - **School of Information and Library Science, University of North Carolina, Chapel Hill**
- Three year (2006 - 2008) funded project
- Partly help achieving NDLTD goals

Project Teams/NSF Grant

- Project Team at VT (IIS-0535057):
  - PI: Dr. Edward A. Fox (fox@vt.edu)
  - GRA: Seungwon Yang (seungwon@vt.edu)

- Project Team at UNC-CH (IIS-0535060):
  - Co-PI: Dr. Barbara Wildemuth (wildem@ils.unc.edu)
  - Co-PI: Dr. Jeffrey Pomerantz (pomerantz@unc.edu)
  - GRA: Sanghee Oh (shoh@email.unc.edu)

Project links

- Homepage

  http://curric.dlib.vt.edu/DLcurric.html

  - overview, other links, progress diary, news & interviews
- Project progress diary

  http://tuppence.dlib.vt.edu/blogs/index.php?blog=2

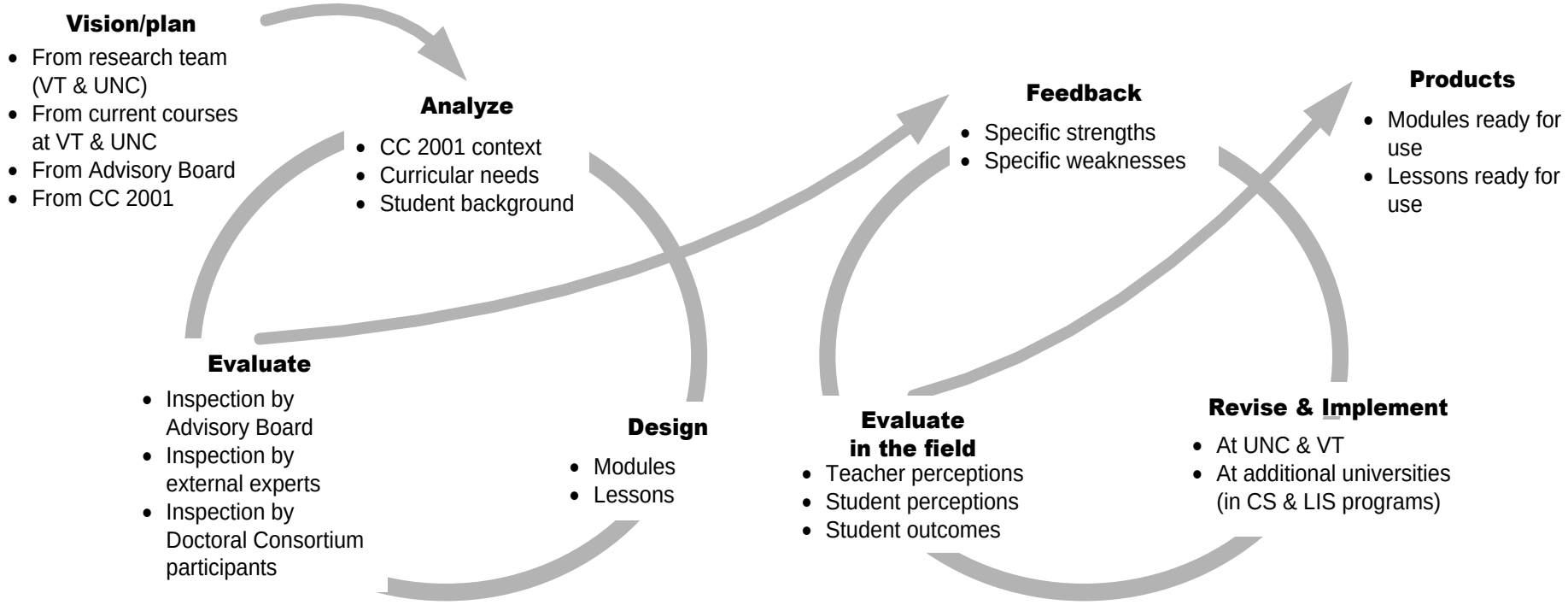
  - discussion summaries, meeting pictures, events, announcements

News and Interviews

- WVTF Public Radio: Morning Edition,
  "Interview with Dr.Fox" [January 30, 2006]
- VT Collegiate Times article [January 26, 2006]
- UNC Gazette article [January 25, 2006]
- Virginia Tech Computer Science Department News article [January 23, 2006]
- Virginia Tech News article [January 20, 2006]

Development / Evaluation Plan

January 2006 – December 2008



Project Timeline

Activities	2006			2007			2008		
	Sp	Su	Fa	Sp	Su	Fa	Sp	Su	Fa
Creation of an advisory board									
Engagement of experts to assist with module development									
Development of modules									
Development of lessons within modules									
Development of 1- and 2-semester courses									
Preliminary evaluation of modules and lessons by experts									
Revision of modules and lessons									
Implementation of modules and lessons in existing courses									
Evaluation of modules and lessons in the field									
Offering of new courses at UNC & VT									
ETD, JCDL and Doctoral Consortium									
ECDL & SIGIR conferences									
ASIS&T conference									
ICADL conference									

What we do:

- Identify, develop and test educational DL modules, guided by
  - Experts and international collaborators
  - Computing Curriculum 2001 [6, 7]
  - 5S framework [1,2,3,4]

    (Ex) Module revision in 3/27/06
  - Analysis of DL course syllabi

    (Ex) UNC-CH is collecting DL syllabi

    VT collected syllabi from DELOS member institutions in Europe
  - Development of module template

Experts / Advisory board members

Table 3. Experts (all have agree to assist)		
Advisory Board	**VT**	**UNC**
Dan Atkins, U. Michigan	Steven Edwards, CS	Catherine Blake, SILS
Christine Borgman, UCLA	Roger Ehrich, CS	Laura Gasaway, Law School
Lillian Cassel, Villanova	Weiguo Fan, ACIS	Jane Greenberg, SILS
Michael Christel, CMU	Steve Harrison, CS	Stephanie Haas, SILS
Raya Fidel, U. Washington	Gail McMillan, Library	Brad Hemminger, SILS
Richard Furuta, Texas A&M University	Chris North, CS	Thomas James, Dean, School of Education
Elizabeth Liddy, Syracuse University	Manuel Pérez-Quiñónez, CS	Paul Jones, Director, ibiblio; SILS & School of Journalism & Mass Communication
Clifford Lynch, CNI	Naren Ramakrishnan, CS	Diane Kelly, SILS
Kurt Maly, ODU	Deborah Tatar, CS	Gary Marchionini, SILS
Javed Mostafa, Indiana	Layne Watson, CS	Montek Singh, CS
Tefko Saracevic, Rutgers		Natasha Smith, Library
Linda Smith, UIUC		Helen Tibbo, SILS
		Steve Weiss, CS

Selected International Collaborators

- India

  Dr. Arun Kumar Chakraborty

  – Bose Institute, Kolkata, India

- Brazil

  Dr. Ricardo da Silva Torres

  – State University of Campinas (UNICAMP), SP, Brazil

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CC2001 Information Management Areas	
IM1. Information models and systems*	IM8. Distributed DBs
IM2. Database systems*	IM9. Physical DB design
IM3. Data modeling*	IM10. Data mining
IM4. Relational DBs	IM11. Information storage and retrieval
IM5. Database query languages	IM12. Hypertext and hypermedia
IM6. Relational DB design	IM13. Multimedia information & systems
IM7. Transaction processing	IM14. Digital libraries

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5S Framework

- Developed by Digital Library Research Laboratory (DLRL) at Virginia Tech
- Strong foundation for DL module development
- Captures entities and medium involved in DLs.
- The five S’s

  - streams, structures, spaces, scenarios, societies

5S Framework

- “Streams”

  - All types of contents

  (as well as communications and flows over networks, or into sensors, or sense perceptions)
- “Structures”

  - Organizational schemes

  (including data structures, databases, and knowledge representations)

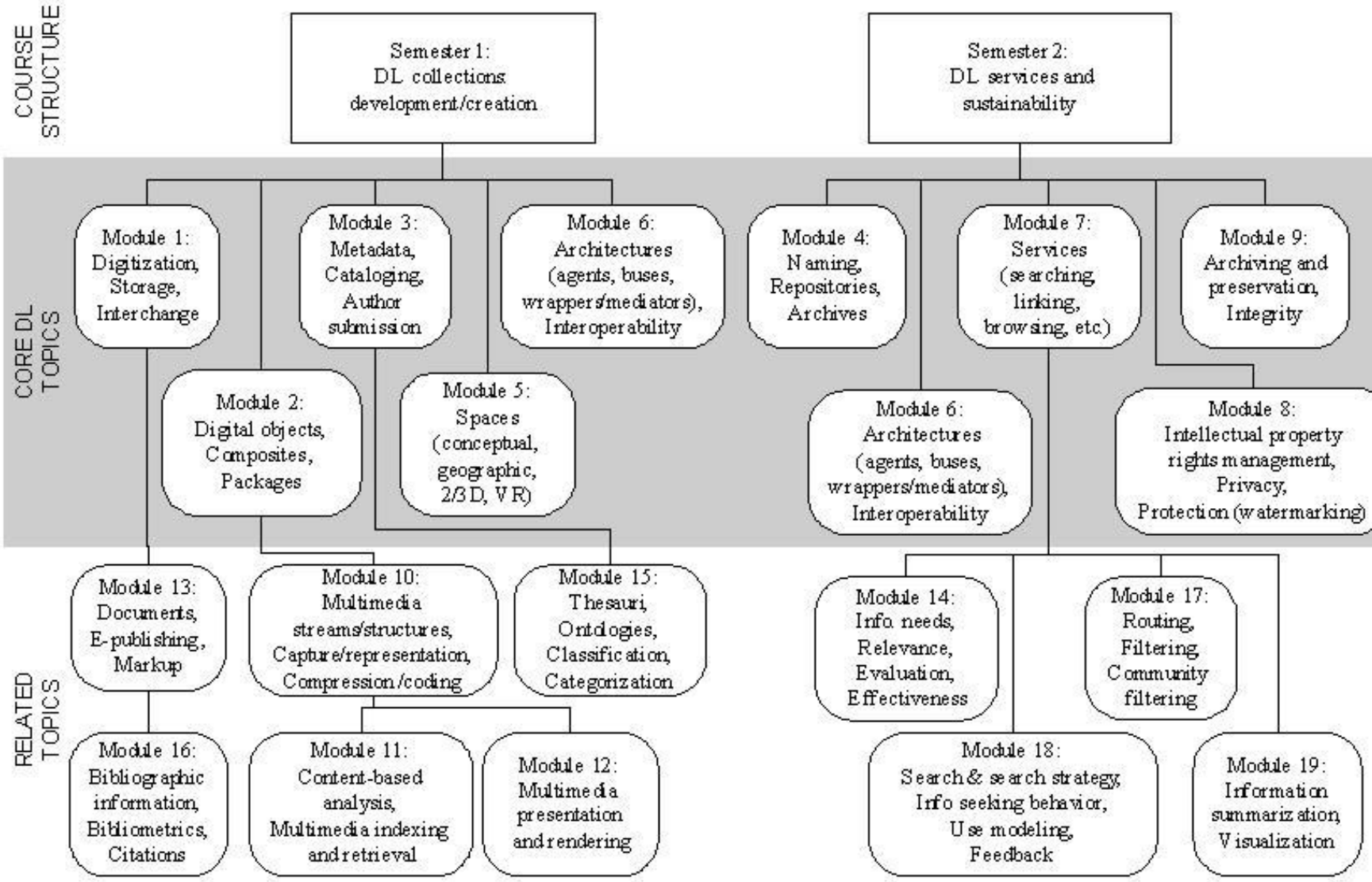
5S Framework

- "Spaces"
  - 2D and 3D interfaces, GIS data, representations of documents and queries.
- "Scenarios"
  - System states and events, but also can represent situations of use by human users (or machine processes, yielding services or transformations of data).
- "Societies"
  - Both software "service managers" and fairly generic "actors" who could be (collaborating) human (users).

5S Examples

Table 7. The 5 Ss		
Ss	**Examples**	**Formalization**
Streams	Text; video; audio; image	Sequence (list)
Structures	Collection; catalog; hypertext; document; metadata	Graph, Function, Relation
Spaces	Used in indexing, browsing, and searching services – as well as interfaces	Set (vector, topological, measurable, measure, probability spaces)
Scenarios	Searching, browsing, recommending	States, events, sequences (lists)
Societies	Service managers (software), Actors (learners, teachers, etc.)	Tuple (relating events and actions)

DL Topics in 19 Modules (original)



Module Revision in 3/27/06

Organized using 5S framework

STREAM

1. Collection Development
   - Digitization
   - Document and E-publishing Markup
   - Harvesting
2. Digital objects/Composites/Packages
   - Text Resources
   - Multimedia streams/structures, Captures/representation, Compression/coding
     - Content-based analysis, Multimedia indexing
     - Multimedia presentation rendering

STRUCTURE

3. Metadata, Cataloging, Author submission
   - Thesauri, Ontologies, Classification, Categorization
   - Bibliographic information, Bibliometrics, Citations
4. Architecture (agents, buses, wrappers/mediators), Interoperability

Module Revision 06/01/06

SPACE

5. Spaces (conceptual, geographic, 2/3D, VR)
   - Storage
   - Repositories, Archives

SENARIOS

6. Services (searching, linking, browsing, etc.)
   - Info needs, Relevance, Evaluation, Effectiveness
   - Search & search strategy, Info seeking behavior, User modeling, Feedback
   - Routing, Filtering, Community filtering
   - Sharing, Networking, Interchange
   - Info summarization, Visualization
7. Archiving and preservation integrity (ILS)

SOCIETIES

8. Intellectual property rights management, Privacy, Protection (watermarking) (ILS)
9. Social issues / Future DLs

What we will do:

- Each module will include
  - Topics
  - Lesson plan
  - Concept maps
  - Recommended reading list
  - Demos / online resources
  - Exercises and quizzes

The first will be developed during this summer…

What we will do:

- Course Development (summer 2006)
  - 1-semester and 2-semester courses will be based on the developed modules

- Courses and modules will be…
  - Evaluated by experts
  - Pilot-tested in CS and LIS courses by the U.S. institutions and our international collaborators in India (Dr. Arun Kumar Chakraborty) and Brazil (Dr. Ricardo da Silva Torres).

Dissemination Efforts

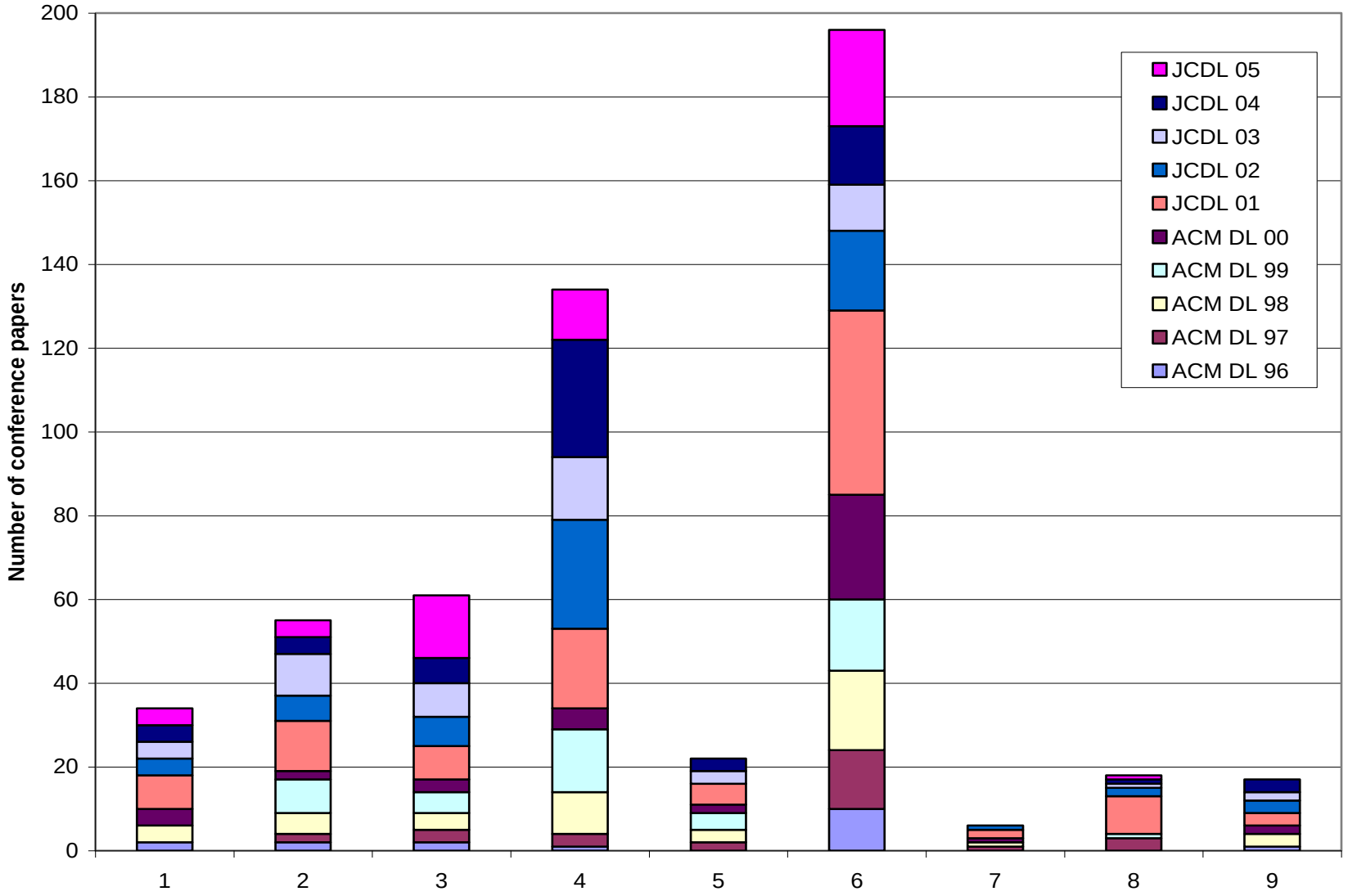
Conference	Type	Status
JCDL 06	Curriculum Development for Digital Libraries (paper)	Accepted
ETD Symposium 06	Digital Library Curriculum Development: Enhancing Education and Comprehension of NDLTD (paper)	Accepted
ICADL 06	Collaborative Research: Community-Oriented Curriculum Development for Digital Library Education (paper)	Planned

Ascertaining Priority Topics

- We've manually classified and analyzed publications using 9-Modules(revised):

	Source	Count
Proceedings	**JCDL '01 – '05**	**354**
Proceedings	**ACM DL '96 – '00**	**189**
Magazine articles	**D-Lib '95 – '06**	**521**
Session titles	**JCDL, ACM DL, ECDL**	**264**

Distribution of Conference Papers across Module Topics



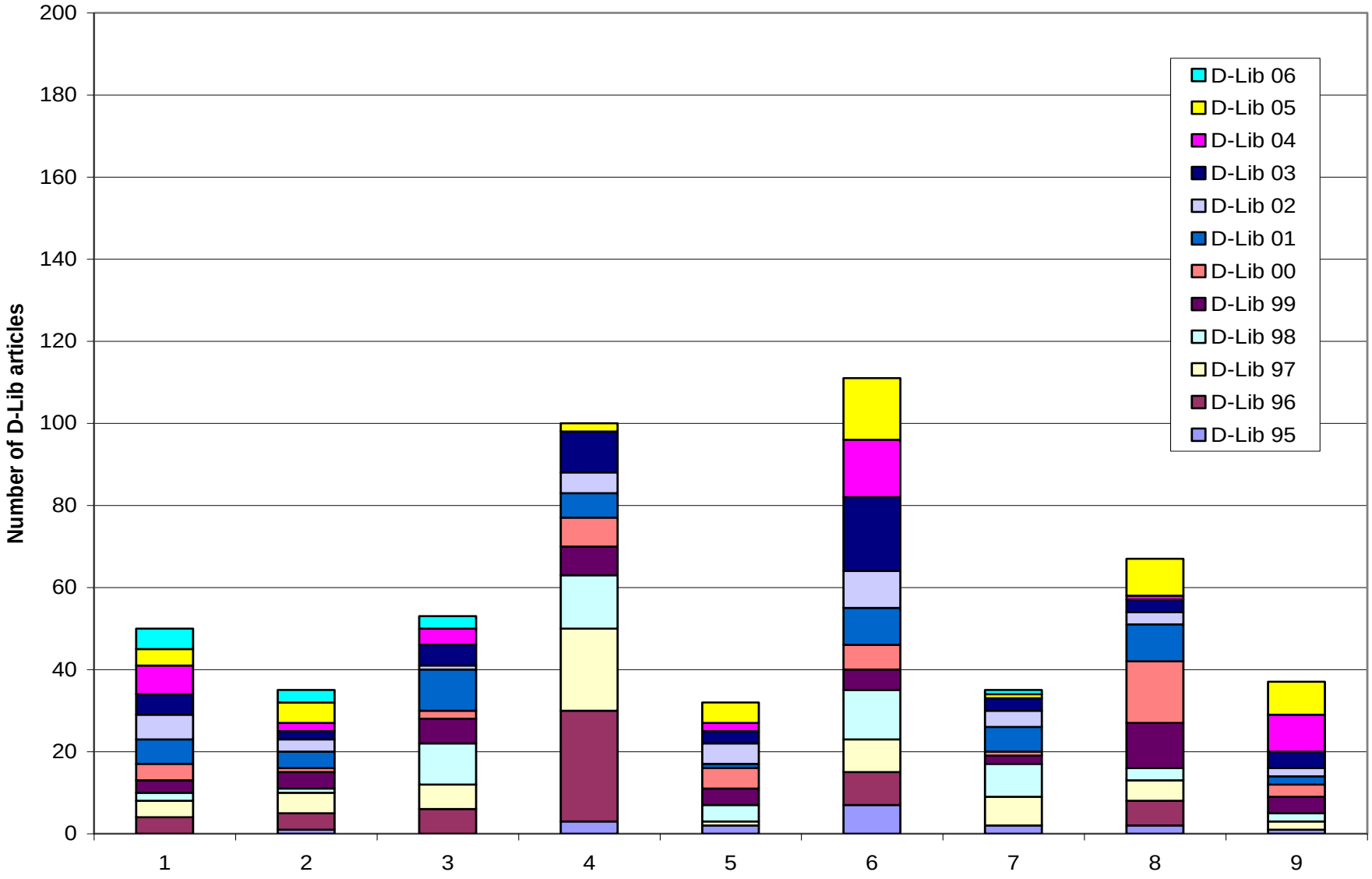
- Analysis Results:

- Total of 543 proceedings:

  Most popular topics were

  architecture (module 4) and services (module 6)

Distribution of D-Lib Magazine Articles across Module Topics



- Analysis Results:

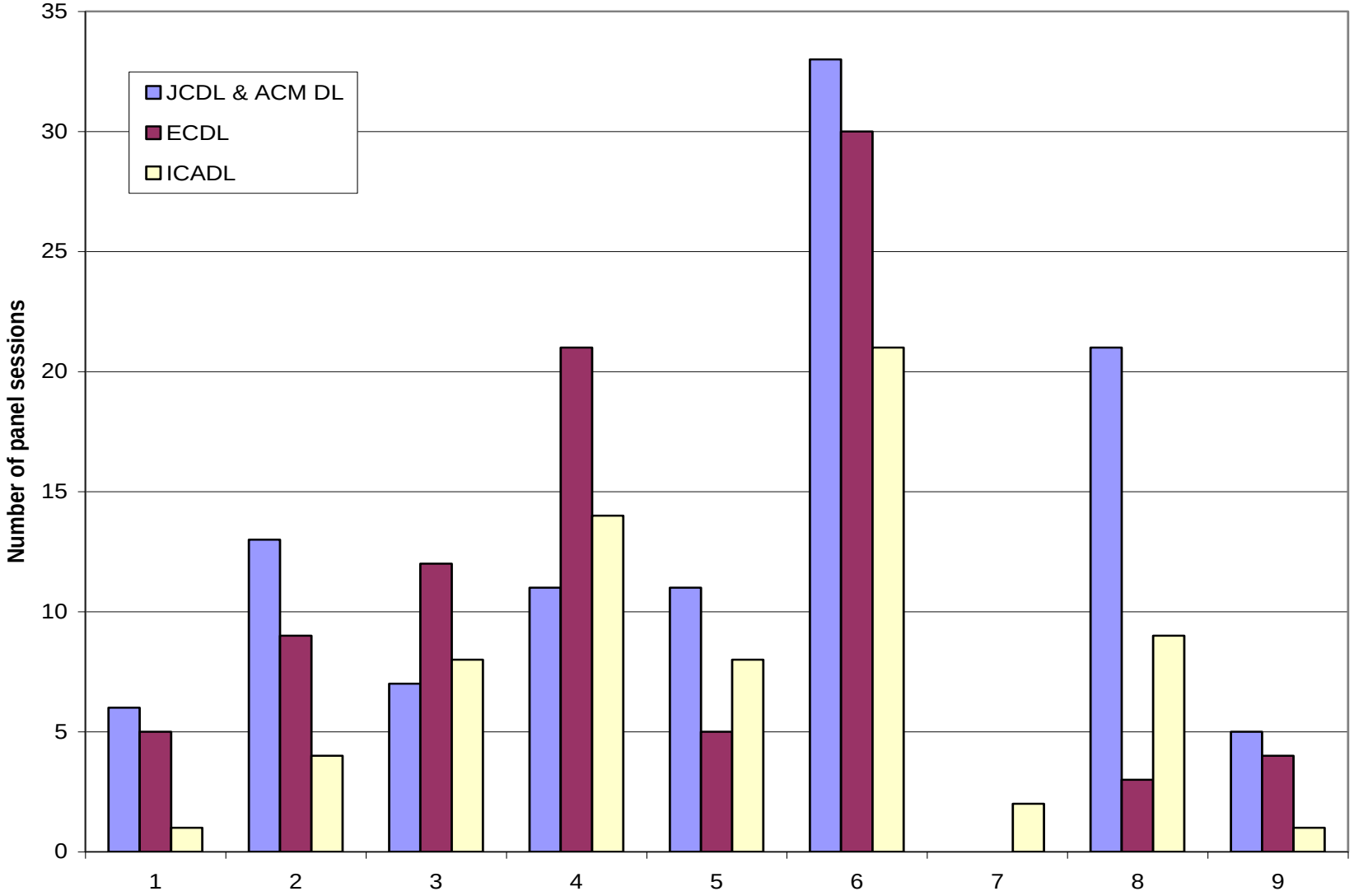
- Total of 521 articles:

  Most popular topics were

  architecture (module 4), services (module 6)

  and social issues (module 9)

Distribution of Session Titles across Module Topics



- Analysis Results:

- Total of 264 session titles (JCDL, ECDL, ICADL):

  Most popular topic was services (module 6)

  followed by architecture (module 4)

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  - Development of module template

Resource Analysis

- European DL course syllabi -

- DL-related course syllabi were collected from
  - DELOS member institutions (Austria, Czech Republic, United Kingdom, Switzerland, Norway, and Germany)
- English resources (reference papers, textbooks, online demo) were retrieved from the syllabi and organized into tables.
- We will expand this effort to include courses in the U.S., Asia, and Oceania.

Example

DL-related courses, and their resources (selected)

Country	University / Institution	Course Title	Books	Papers	Online
Austria	Institute for Information Systems and Computer Media - IICM	Multimedia Information Systems 2	0	0	59
		Information Visualisation	22	4	4
	Vienna University of Technology	Informationsvisualisierung	7	0	0
Czech Republic	Masaryk University of Brno	Informatics Colloquium	1	0	0
		Multimedia data indexing	1	0	0
Germany	Max-Planck-Institut für Informatik	Information Retrieval and Data Mining WS 2005/06	18	0	0
		Information Retrieval and Data Mining WS 2002/2003	6	0	0
	Universität Duisburg-Essen	Information Regrieval	3	0	1

Example

Top 20 recommended books/textbooks list (selected)

Count	Topic	Title	Author
11	Information Retrieval	Modern Information Retrieval	Ricardo Baeza-Yates, Berthier Ribeiro-Neto
5	Information Retrieval	Information Retrieval	van Rijsbergen C.J.
5	Searching/cognition.	Finding Out About: Search Engine Technology from a cognitive Perspective	Richard, K. Belew
3	Information Retrieval	HySpirit - Integrating Information Retrieval and Database Technologies	Roelleke T., Lalmas M. and Luebeck R.
3	Information Retrieval	Introduction to modern information retrieval.	Chowdhury, G. G.
2	Classification	Pattern Classification	Richard O. Duda, Peter E. Hart, David G.Stork
2	Language Processing	Foundations of Statistical Natural Language Processing	Christopher D. Manning, Hinrich Schütze

Example

Reference paper list (selected)

Topic	Title	Author
Database	Maintenance of Materialized Views: Problems, Techniques, and Applications	Ashish Gupta et al.
Digital Library	A Spectrum of Interoperability. The Site for Science Prototype for the NSDL.	William Y. Arms et.al.
Digital Library	Automated Digital Libraries. How Effectively can Computers be used for the Skilled Tasks of Professional Librarianship?	William Y. Arms
Digital Library	Digital Libraries, value, and productivity.	Wiederhold, G.
Digital Library	Going Digital: A Look at Assumptions Underlying Digital Libraries	David M. Levy et al.
Digital Library	Harvard's Library Digital Initiative. Building a first Generation Digital Library Infrastructure.	Dale Flecker
Digital Library	The Next Stage: Moving from Isolated Digital Collections to Interoperable Digital Libraries.	Besser, Howard.

Example

Online documents list (selected)

Topic	Title	URL
Application program	HyperCard	http://en.wikipedia.org/wiki/HyperCard
	Visual knowledge builder	http://www.cs.tamu.edu/VKB/vkb_download.html
Data access object	J2EE Patterns: Data Access Object	http://java.sun.com/blueprints/corej2eepatterns/Patterns/DataAccessObject.html
Database	Agile Database Techniques	http://www.ambysoft.com/agileDatabaseTechniques.html
	Datenbanken Artikel	http://onjava.com/topics/java/jdbc_sqlj
Hibernate	Get started with Hibernate	http://www.javaworld.com/javaworld/jw-10-2004/jw-1018-hibernate.html
	Hibernate Reference Manual	http://www.hibernate.org/hib_docs/v3/reference/en/html/
	Hibernate Your Data	http://www.onjava.com/pub/a/onjava/2004/01/14/hibernate.html
	Struts Recipes: Hibernate and Struts	http://www.javaworld.com/javaworld/jw-01-2005/jw-0124-strutshibernate.html
html	A List Apart	http://www.alistapart.com/

Links to Resources

Excel files can be downloaded from the links below.

- Corpus Table Download Link

http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseCorpusTable-v1.xls

- Textbook Analysis Table Download Link

http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseBookAnalysisTable-v1.xls

- Reference Paper Analysis Table Download Link

http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCoursePaperAnalysisTable-v1.xls

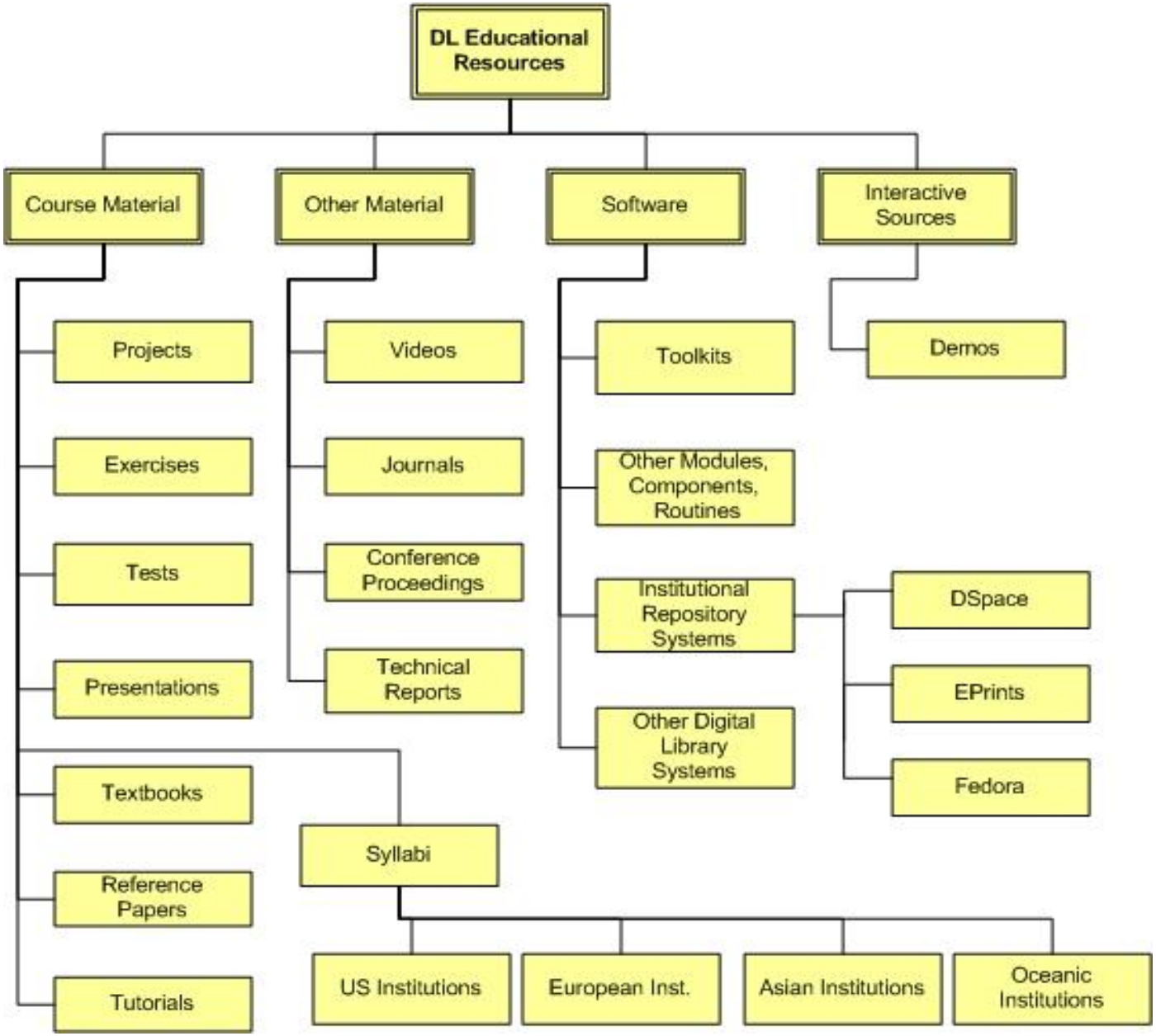
- Online Documents and Tutorials Analysis Table Download Link

http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseOnlineDocTutorialsAnalysisTable-v1.xls

- Taxonomy Development:

  - By examining the syllabi and current DL courses, we developed a Taxonomy of DL Educational Resources

Taxonomy of DL Educational Resources



Textbook on DLs

- PI Fox, along with co-author Gonçalves, is preparing a textbook on DLs based on 5S
- This work will rely on the 5S framework to ensure that it provides integrated coverage of the many concepts related to DLs
- Fox and Gonçalves are focused on a book for teaching as well as reference

Textbook Outline

- Ch. 1. Introduction (Motivation, Synopsis)
- Part 1 – The “Ss”
  - Ch. 2: Streams
  - Ch. 3: Structures
  - Ch. 4: Spaces
  - Ch. 5: Scenarios
  - Ch. 6: Societies

Textbook Outline

- Part 2 – Higher DL Constructs
  - Ch. 7: Collections
  - Ch. 8: Catalogs
  - Ch. 9: Repositories and Archives
  - Ch. 10: Services
  - Ch. 11: Systems
  - Ch. 12: Case Studies

Textbook Outline

- Part 3 – Advanced Topics
  - Ch. 13: Quality
  - Ch. 14: Integration
  - Ch. 15: How to build a digital library
  - Ch. 16: Research Challenges, Future Perspectives
- Appendix
  - A: Mathematical preliminaries
  - B: Formal Definitions: Ss
  - C: Formal Definitions: DL terms, Minimal DL
  - D: Formal Definitions: Archeological DL
  - E: Glossary of terms, mappings

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    (Ex) Module revision in 3/27/06
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  - Development of module template

Module Template

- Module Design is based on the resources below and the UNC's module template

[1] Yue-Ling Wong, Jennifer Burg, and Leah McCoy, "Integrated Digital Media Curriculum Development Project" Supported by the National Science Foundation under Grant No. DUE-0340969, from Jan 2004 - Dec 2006. The project homepage URL is http://digitalmedia.wfu.edu/project/digital-media-curriculum-development/textbased-index.html

[2] Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia" at http://www.cs.sfu.ca/mmbook/

[3] Multimedia Systems course website, Department of computer science at University of Victoria, British Columbia, Canada. URL: http://www.csc.uvic.ca/courses/spring2004/csc/461-561.html

Module Template

- VT Template + UNC Template - June 2, 2006 (draft)

1. Module name
2. Learning objectives
3. Level of effort required (in-class and out-of-class time required for students)
4. Prerequisite knowledge required (completion optional)

Module Template

5. Relationships with other modules
6. 5S characteristics of the module
7. Introductory remedial instruction

   (completion optional: intended to address the prerequisite knowledge/skills required)

8. Resources (textbooks, required and optional readings for instructors and students)

   → Plan A: this section includes resources of all topics in a module

Module Template

9. Body of knowledge (Theory + Practice)
   Topics might be skipped or studied in different orders

Topic 1

– Theories and background knowledge of the topic
– Learning activities
  - Presentation slides
  - Interactive demo
– Resources
  - Textbooks (relevant parts might be marked with SI tool)
  - Reference papers (relevant parts might be marked with SI tool)
  - Advanced reading
  - Worksheets

Topic 2

….

Topic 3

Module Template

10. Concept map (created by students)
11. Exercises / Learning activities
12. Evaluation of learning outcomes
13. Glossary
14. Useful links

Module Template Example

-Multimedia Module-

Summary

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Conclusions

- We hope that this project, DL curriculum development, would help achieving NDLTD goals benefitting students, universities and the world.

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- For Students:
  - **Gain knowledge and skills for the Information Age**
  - **Richer communication (digital information, multimedia, …)**
- For Universities:
  - **Easy way to enter the digital library field and benefit thereby**
- For the World:
  - **Global digital library – large, useful, many services**

References

[1] M. Gonçalves, E. Fox, L. Watson, and N. Kipp, “Streams, Structures, Spaces, Scenarios, Societies (5S): A Formal Model for Digital Libraries,” ACM Transactions on Information Systems, vol. 22, pp. 270-312, 2004.

[2] M. A. Gonçalves, “Streams, Structures, Spaces, Scenarios, and Societies (5S): A Formal Digital Library Framework and Its Applications,” Computer Science Doctoral Dissertation. Blacksburg, VA: Virginia Tech, 2004, 161 pages. http://scholar.lib.vt.edu/theses/available/etd-12052004-135923/unrestricted/MarcosDissertation.pdf

[3] M. A. Gonçalves and E. A. Fox, “5SL - A Language for Declarative Specification and Generation of Digital Libraries,” in Proc. JCDL’2002, Second ACM / IEEE-CS Joint Conference on Digital Libraries, July 14-18, G. Marchionini, Ed. Portland, Oregon, USA: ACM, 2002, pp. 263-272.

References

[4] Q. Zhu, “5SGraph: A Modeling Tool for Digital Libraries,” Department of Computer Science MS thesis. Blacksburg: Virginia Tech, 2002. http://scholar.lib.vt.edu/theses/available/etd-11272002-21053

[5] NDLTD, Networked Digital Library of Theses and Dissertations. available at http://www.ndltd.org, 2006

[6] CC2001, “Computing Curricula 2001: Computer Science (IEEE Computer Society and Association for Computing Machinery Joint Task Force on Computing Curricula),” Journal on Educational Resources in Computing (JERIC), vol. 1, 2001. http://doi.acm.org/10.1145/384274.384275

[7] CC2001, “Computing Curricula 2001 (Web Site),” vol. 2004: ACM and IEEE-CS, 2001. http://www.computer.org/education/cc2001

Thank you!

Extras