Digital Library Education: The Current Status

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ABSTRACT

In this paper, we review and examine the current status of digital library education and compare the range of provision with that found in earlier studies [1, 2, 3]. It is found that the number of institutions offering programmes or courses in digital library education is still increasing. About 43% of these programmes or courses are stand–alone rather than integrated with wider material. The curriculum design and focused teaching areas appear more systematic and comprehensive than in earlier studies. Over half the institutions examined in this study have posted their detailed course information on-line. Most courses offered are now based on a combination of theory and practice, and are available at different levels. There are increasing opportunities for funding for developing new initiatives in digital library education. However, since digital library education is still at an early stage, an optimized model of best practice in digital library education has not yet emerged.

Categories and Subject Descriptors

H.3.7 [**Information System**]: Information Storage and Retrieval Language – Digital libraries

General Terms

Digital Libraries, Education.

Keywords

Digital Libraries, Education Institutions, Curriculum Design and Development, Demands and Needs, Library Information Specialist

1. INTRODUCTION

Nowadays, libraries exist in many forms and are of many types. Recent developments in information and communication technologies, especially computers and the Internet, have brought significant changes in the way we generate, distribute, collect, access and use information and libraries. Digital technologies and their applications have also come into every part of our daily life. It is accepted that we are now living in a digital world.

The history of digital libraries can be characterized as short and volatile. The Digital Library (DL) is a new form of managing the knowledge record and cultural heritage. Thousands of digital collections have been, and will continue to be, created around the world. Large amounts of research effort and money have been devoted to digital library research throughout the world over the past decade [4, 5]. Digital collections such as institutional repositories, cultural heritage curated digitally and a variety of versions of digital libraries are blooming worldwide. However, many organizations have found that the pool of information professionals with the expert knowledge and skills to create and manage digital collections is very small. It is evident that there is already s shortage of supply, a lack of information professionals with the right combination of skills, and it is particularly serious in specialist areas such as digital librarians [6, 7]. DL education is faced with many questions and it is clear that there is a pressing need to develop suitable education programmes to train and equip new librarians and information professionals who will be capable and comfortable in working in a digital environment. Digital library education can be defined as the programmes or courses specific to the training and educating of students who will be able to build and manage digital libraries after graduation. The combination of social trends and technology is here the push for educational developments [1].

Research on digital library education shows it is still at the stage where people are exploring particular questions such as "Where are DL courses being taught?", "Why teach digital libraries?" and "What, and how, to teach about digital libraries" [1, 2, 3, 8, 9].

The aims of this study are to identify and examine current courses or programmes in digital library education, and consider the need for digital librarians, the skills required by digital libraries and how best to educate and train digital librarians.

2. METHODOLOGY AND DATA

2.1 Methodology

It is clear that the topic of this study is a new and fast moving one. The methodology applied in this study is a combination of a comprehensive literature review (largely for historical comparisons) and an on-line data collection exercise. The evidence and data collected here are mainly based on the literature review and on-line information posted by educational institutions in the digital library sector.

2.1.1 Literature Review

The literature reviewed included definitions and historical development in the areas of digital library and digital library education, the current situation in digital library education, and the states of its research and applications, to determine:

- Why and what to teach regarding digital libraries?
- How many institutions are teaching digital libraries, and what reasons do they give for doing so?
- What are the current teaching emphases, course outlines and structures of programmes in this area?
- What is the latest thinking on what is best practice in digital library education?
- Do any of the courses surveyed come close to a model of best practice?

As this is a topic which could involve several subject domains, a cross-disciplinary literature search was considered to be a suitable approach. Information from the literature review was then used to undertake more detailed on-line data collection.

2.1.2 On-line Data Collection

It would be certainly ideal to carry out a detailed survey with, e.g. questionnaires to library schools together with interviewing key people in DL area. However, due to the time limitation of this study, it was simply not realistic to carry out work on this scale. There is considerable value in a follow-up study to earlier research work, with a priority to collect updated data and compare the range of provision with that found in earlier surveys [1, 2, 3,]. Also, collecting the type of data in a study such as this one, to give an overview of the current status of DL education, is an essential base for the development of a more thorough research programme. Therefore, a desk survey was selected and used in this study.

The on-line data collection was carried out mainly during the period from August to September 2005. The websites searched were those maintained by institutions with ALA (American Library Association) accredited programmes in the USA and Canada and those universities with library study programmes accredited by CILIP (the Chartered Institute of Library and Information Professionals) in the UK. All URLs were valid at the end of September 2005

Although there are some digital libraries courses offered by computer science and other related disciplines, as there are huge numbers of Computer Science (CS) education programmes, it was simply not realistic to scan all of them in this study. For CS-based programmes, therefore, a limited check has been undertaken, principally based on the information from three previous surveys [1, 2, 3].

2.1.3 Data Analysis

The information available was very variable and so it is hard to examine it in a standardised way. Date collection and analyses were made on the following assumptions and conditions.
- All digital library programmes / courses that were / are currently available would very likely be shown on-line, as would programmes / courses planned for the next academic year e.g. autumn of 2005.
- There was a slight variation in course or programme titles, including digital library, digital libraries, digital librarianship, as well as foundation of digital library, digital heritage, archives and libraries in the digital world, dynamic librarian in the digital age and digital resources in humanities.
- Institutions offering digital library courses /programmes but not posted on the Web, would, of course be additional to these discussed here, as would any offered though computer science or other disciplines not picked up.
- Some institutions offer a range of courses which may be related to digital libraries, but which may not have this phrase in their title and so may have been missed in this study.
- Regarding terminology, we take the term 'programme' to mean a set of individual 'courses', 'units' or 'modules'. A programme would therefore lead to a particular qualification such as a Certificate, Diploma or Degree, and if this programme has a distinct overall focus on DL studies then we regard this as an independent full DL programme. Otherwise we refer to an individual DL-focussed course.

2.2 Data

The detailed data collected in this study was imported into a Microsoft Access data base [10]. Data is summarized in the following tables.

2.2.1 Institutions Offering Digital Library Education

Library schools with CILIP (in the UK) and ALA (USA and Canada) accredited programmes offering digital library education are listed in Table 1 and 2. There were 56 institutes in total with ALA accredited programmes in Library and Information Science (LIS) area in the USA and Canada. There were 18 universities in total in LIS accredited by CILIP in the UK.

As described in 2.13, the term 'Programme' here means a set of individual 'courses', 'units', or 'modules' specialized or concentrated on DL. In the following Tables 1 to 3, the institutions with '*' symbol are considered as 'DL programmes', and the rest are considered as individual DL-focused courses.

Table 1. Institutions with CILIP accredited courses offering DL courses

No	Institutes	Courses / Programmes Title & Syllabus	Department	Level
1	City University	SOI Digital Library. Course Description at http://www.soi.city.ac.uk/pgcourses/module_list.html#digital%20libraries	School of Informatics	MA / MSc
2*	London Metropolitan University	Digital Information Management. Programme Description at http://www.londonmet.ac.uk/pg-prospectus-2005/courses/digital-information-management.cfm	Information Management School	MSc or Certificate From 2005
3*	Strathclyde University	67.977. Digital Libraries in Digital Library Programme, Programme Description at : http://www.gsi.strath.ac.uk/gsi/dl-info.html	Graduate School of Informatics	MSc from 2005
4	University College London	G008 Digital Resources in Humanities. Course Description at http://www.ucl.ac.uk/prospective-students/gr-degrees-2005/arts-and-humanities/library-archive-and-information-studies/taught/course-descriptions/index.shtml	School of Library Archive and Information Studies	MSc

Table 2. Institutions with ALA accredited programmes offering DL courses

No	Institutes	Courses title & Syllabus	Department	Level
1	Alabama, University of	CIS 661: Digital Library. Course Syllabus at: http://webapp.slis.ua.edu/dlibsyllab/syllabus.htm Rely on Distance Learning	School of Library and Information Science (LIS)	MA / Msc Ph.D
2	Alberta, University of	LIS 538: Digital librarianship. Course Syllabus at: http://www.ualberta.ca/~dzhao/courses/538/538_outline.htm	School of Library and Information Studies	MLIS
3	British Columbia, University of	LIBR 559E: Digital Libraries. Course Description at: http://www.slais.ubc.ca/COURSES/coursdes/libr/libr559e.htm Course Syllabus at: http://www.slais.ubc.ca/courses/libr559e/04-05-wt1/SYLLABUS.htm	School of Library, Archival and Information Studies	MLIS
4	Catholic University of America	LIS 712: Foundations of Digital Library. Course Description at: http://slis.cua.edu/courses/courses.cfm#712 Last on fall 2004, perhaps.	LIS	MLIS
5	Dalhousie University	LIB6840: Digital Library (Distance learning). Course Syllabus at: http://sim.management.dal.ca/Courses/Courses_Offered/LIBS6840.php	School of Information Management	MLIS & DLIS
6	Dominican University	LIS 759 Digital Library. Course Syllabus at: http://domin.dom.edu/faculty/kmarek/lis759/index.html	Graduate School of LIS	MLIS
7*	Drexel University	INFO 653: Digital Libraries. Course Content at: http://www.drexel.com/Fields_of_Study/information_sciences/MDI/curriculum.shtml#INFO653 On-line learning programme information at: http://www.drexel.com/Fields_of_Study/information_sciences/MDI/index.shtml	College of Information Science and Technology	MLIS Certificate in Digital Information Management
8*	Florida State University of	Dynamic Librarian in Digital Age. Specialist Degree Programme Description at: http://ci.fsu.edu/Prospects/ssd51_infoprofessions_desc.cfm	College of Information	Juris Doctor & MSc
9	Hawaii University of	LIS 671 Digital Librarians. Course Syllabus at: http://www.hawaii.edu/slis/courses/syllabi/671_jacso.pdf Reading list at: http://www2.hawaii.edu/~jacso/	Information and Computer Science	MLIS & MICS
10*	Illinois, University of At Urbana Champaign	Certificate of Advanced Study (CAS) in Digital Library. Programme Description at : http://www.lis.uiuc.edu/programmes/cas-dl.html LIS 590D Digital Libraries: Research and Practice. Course Note at: http://www.lis.uiuc.edu/oc/courses/course-detail.html?id=LIS590DIL&year=2005&semester=FA	Graduate School of LIS	Certificate in DL & (CAS) post-Master
11*	Indiana University of	Digital Library Education Programme (DLEP) Full programme includes a list of courses and syllabuses at: http://lair.indiana.edu/research/dlib/details/index.php L566 An Introduction to Digital Library. Course Syllabus at: http://ella.slis.indiana.edu/~skowalcz/Teaching/2005/L566/index.html	School of LIS	MLS / MIS & post MLIS (DLEP)
12	Iowa, University of	021 226 Digital Libraries. Course Description at: http://www.uiowa.edu/~libsci/descriptions.html Course syllabus at: http://mingo.info-science.uiowa.edu:16080/courses/226/	School of LIS	MA / MSc
13	Louisiana State University	LIS 7410 Digital Library. Course Syllabus at: http://slis.lsu.edu/syllabi/7410.pdf	School of LIS	MLIS
14	Maryland University of	LBSC 708 Digital Library Technology & Policy. Course Plan at http://www.clis.umd.edu/courses/teaching_plan.html (plan for 2004-2005)	College of Information Study	MLIS

15*	Michigan, University of	SI 615 Special topics: Digital Library (Archives & Records Management Specialisation for Cybrarian). Course Description at: http://www.si.umich.edu/courses/description.htm?passCID=299	School of Information	MLIS Certificate in ARMS
16*	Missouri-Columbia, University of	9409 Digital Libraries. Course Description at: http://sislt.missouri.edu/descriptions.php Project based & Certificate on Digital Media Programme Description at:: http://sislt.missouri.edu/digitalmedia.php	School of IS & Learning Technologies	MLIS & PhD Certificate in Digital Media
17	North Carolina-Chapel Hill, University of	INLS 235: Digital Libraries: Principles and Applications. Course Description at: http://sils.unc.edu/programmes/courses/descriptions.html INLS 210-040 Modules of Libraries (or digital libraries) Operations and Evaluations. Special topic Course Description at: http://sils.unc.edu/programmes/courses/special_topics.html	School of LIS	MLIS
18*	Pittsburgh, University of	Digital Libraries Specialization: Recommended programme content at: http://www.sis.pitt.edu/%7Edlis/academics/specializations/digital.html LIS 2670 Digital Libraries. Course Description at: http://www.sis.pitt.edu/%7Edlis/academics/course_descriptions/course2600.html#2670	School of IS, Department of LIS	MLIS & Certificate in DL Specialisation
19*	Queens college, City University of New York	GSLIS 753 Digital Libraries Course Description at: http://qcpages.qc.cuny.edu/GSLIS/courses.html Certificate in Archives, Records Management & Preservation. Programme description at: http://qcpages.qc.cuny.edu/GSLIS/certificate%20archives.htm	Graduate School of Library and Information Studies	MLS & Certificate in ARM & P
20	Rhode Island, University of	Summer Projected Summer Course 597 Digital Libraries. Course Description at; http://www.uri.edu/artsci/lsc/web/Academics/Courses/rotation-schedule-RI.shtml From 2006	Graduate School of Library and Information Studies	MLIS
21*	Rutgers University	Digital Libraries Concentration On-line Programme. Programme Content at: http://www.scils.rutgers.edu/programmes/lis/OnlineMLIS.jsp 553 Digital Libraries. Course Syllabus at: http://www.scils.rutgers.edu/~tefko/Courses/553/553%20Fall%2002%20s23yllabus.htm	School of Communication, Library and Information Study	MLIS with DL Concentration (CAS)
22	Simmons College	LIS 462 Digital Libraries. Course Description at: http://www.simmons.edu/gslis/academics/courses/electives.shtml Course Syllabus at:http://web.simmons.edu/%7Eschwartz/462.html	Graduate School of LIS	MLIS
23	South Carolina, University of	SLIS 725 Digital Library, Course Syllabus at: http://www.libsci.sc.edu/facst/kim/725/05fall/courseHome.html	School of LIS	MLIS
24*	South Florida University of	LIS 5937: Digital Library. Course content at: http://www.cas.usf.edu/lis/gen/summer05.htm Course Syllabus at: http://www.cas.usf.edu/lis/syl/sum05/5937gregory.htm	School of LIS, College of Art & Science	MLIS (web & blended)
25	Southern Connecticut State University	ILS 655: Digital Library. Course Description (on line) at: http://www.southernct.edu/departments/ils/coursedescription.htm	Department of LIS	MLS (on line)
26*	Syracuse University	IST 676 Digital Libraries. Programme Description at: http://www.syracuse.edu/publications/gradcat/ist.pdf On-line Learning and CAS at http://www.ist.syr.edu/academics/graduate/mls/digitallibraries/index.asp	Graduate School of LIS	CAS in Digital Libraries
27	Tennessee, University of	IS 565 Digital Library. Revised Course Description at: http://www.sis.utk.edu/programmes/masters/curriculumChanges/courseChanges/view?searchterm=digital%20Libraries Course Syllabus at: http://www.sis.utk.edu/~sallard/IS565syllabus.pdf	School of Information Sciences	MIS on campus and on-line
28*	Texas-Austin, University of	INF 385S Digital Library Principle and Development. Course Description at: http://www.ischool.utexas.edu/courses/course_details.php?CourseID=283 CAS Programme Description in Digital Library at: http://www.ischool.utexas.edu/programmes/certificates/cas.php	School of Information	CAS in DL

No	Institutes	Courses title & Syllabus	Department	Level
29*	Toronto, University of	FIS 2199 Digital Heritage, Course Description and Syllabus at: (fall 2003) http://www.fis.utoronto.ca/programmes/courses/LIS/2199/index.html CAS Electronic /Digital Information Services Courses List at: http://www.fis.utoronto.ca/programmes/calendar/concentration.htm#Elec	Faculty of Information Studies	MLIS & CAS
30	Wayne State University	LIS 7740 Archives and Libraries in the Digital World (new course from Fall 2005). Course Profile at: http://www.lisp.wayne.edu/courses/courseprofiles/LIS%207740.doc	The LIS Programme	MLIS
31	Western Ontario University of	MLIS 520 Digital Library. Courses Description at: http://www.fims.uwo.ca/mlis/courses/520.htm#TopOfPage	Faculty of Information and Media Studies	MLIS
32*	Wisconsin-Milwaukee, University of	IT concentration (IT) 635 Digital Libraries. Programme Content at: http://www.uwm.edu/Dept/SOIS/academics/MLIS/mlisdegrees.htm#ittrack Course Syllabus at: http://websites.usu.edu/UWMSOIS/Document/index.asp?Parent=5449	School of Information Studies	MLIS & CAS

Table 3. A partial listing of Institutions offering DL courses in Computer Science in the USA, Canada & UK, and SOME other Institutions offering DL courses from the rest of world (see text)

No	Institutes	Courses title & Syllabus	Department	Level
1*	Hebrew University of Jerusalem	SLAIS 02820 Digital Libraries. Course Description at: http://libnet.ac.il/~elhanan/dlibs/huji/	School of Library, Archive and Information Studies	MSc & MLIS
2	Hong Kong University (China)	MLIM 6203 Digital Libraries: Principles and Applications. Course Description at: http://www.hku.hk/education/programmeme2002/r&s/mlim_r&s2005.doc	The Faculty of Education	MSc / MLIS
3	Imperial College London (UK)	CS 342 Digital Libraries. Course Syllabus at: http://mmir.doc.ic.ac.uk/dl-2004/index.html (Autumn 2004)	Department of Computing	MSc
4*	Johns Hopkins University (USA)	New Concentration in Digital Technologies. Programme Description at http://www.jhu.edu/advanced/communication/concentrations.html#digtech	School of Art & Science Communication in Contemporary Society	MA Certificate in Concentration IT
5	Nanyang Technological University (Singapore)	CI6125 Enterprise Portals and Digital Libraries. Course Description at: http://www.ntu.edu.sg/sci/graduate/systems.html#ci6125	School of Communication & Information	MSIS & Ph.D
6	Old Dominion University (USA)	CS 695 Introduction to Digital Libraries. Course Syllabus for Fall 2005 at : http://www.cs.odu.edu/~mln/teaching/cs695-f05/	Computer Science	MSc UG
7	Oswego State University of New York (USA)	ISC 490 Special topic: Digital Libraries. Course syllabus at: http://cs.oswego.edu/~ychoi/ISC490/syllabus490.htm	Computer Science	MSc
8*	Princeton University (USA)	CS 598F Issues in Discovery & Use of Digital Information. Seminar in 2005 and its description at http://www.cs.princeton.edu/courses/archive/spring05/cos598F/ Its syllabus at: http://www.cs.princeton.edu/courses/archive/spring05/cos598F/gen_resources.html	Computer Science	Graduate & advanced UG
9	Queensland University of Technology (Australia)	ITN 316 Digital Library Systems. Course Outline at:: http://www.courses.qut.edu.au/cgi-bin/WebObjects/Courses.woa/wa/selectUnitFromCourseDetails?courseID=2970&structureID=all&unitID=ITN316&strUnitOutlineSelect=ucITN316%7Cuv1%7Cov1%7CctSEM-2%7Csn945%7Cui	Faculty of Information Technology	Master of IM (Part-Time study)
10*	Surrey University of (UK)	CSM 16 Digital Library and Multimedia Applications in Internet Computing. Programme description at:: http://portal.surrey.ac.uk/pgstudy/eps/computing/taught/internetco	Computer Department	MSc & PG Diploma

		mp.jsp		
11*	Texas A & M University (USA)	CPSC 675 Digital Libraries: Special programme in digital libraries study. Programme Description at: http://www.csdl.tamu.edu/csdl/academics/academics.html CPSC 675 Digital Libraries. Course syllabus and all materials at: http://www.csdl.tamu.edu/~leggett/courses/dl/	Centre for the Study of Digital Libraries	MSc with Specialisation in DL
12*	Tilburg University (Netherlands)	The Digital Library Summer Course. Course Content for 2005 at:: http://www.ticer.nl/05carte/index.htm	Tilburg Innovation Centre for Electronic Resource	Professional training
13	Virginia Tech (USA)	CS 6604 Digital Libraries, Course Syllabus at: http://collab.dlib.vt.edu/runwiki/wiki.pl?DlSyllabus05	Computer Science Department	MSc, UG & Ph.D
14*	Victoria University of Wellington (New Zealand)	INFO 547 Digital Libraries. Course Description at: http://www.sim.vuw.ac.nz/degrees/mlis/547-details.aspx	School of Information Management	MLIS & Certificate Diploma
15	Waikato University of (New Zealand)	COMP417B & 517-Digital Libraries course. Course Description at : http://www.scms.waikato.ac.nz/genquery.php?linklevel=4&linklist=SCMS&linkname=Level_45&linktype=report&listby=Paper_Number&lwhere=unique_record_id=49&children	School of Computing & Mathematical Science	MSc & UG

2.2.2 Data Summaries

Table 4. Summary of institutions offering digital library education from 1999 to 2005

Year of survey	2005 [10]*	2004 [3]	2001 [1]	1999 [2]
No or % of Institutions with CILIP accredited programmes	4 or 22% (4/18)	2	1	1
No or % of Institutions with ALA accredited programmes	32 or 57% (32/56)	21	15/32	10
No of Some Institutions from CS or some others (LIS) from the rest of world	7 (CS) 8 (LIS)	8(CS) 9(LIS)	2(CS) 2(LIS)	4 (CS) 4(LIS)
In total	51	40	20 (52)	19

* Number in [ ] is the number of the reference

Table 5. Summary of distribution of format / type of DL programmes or courses offered by LIS (from CILIP and ALA), CS or other professionals

No of Institutions	LIS-CILIP	LIS-ALA	CS	LIS-Others	Total No
Independent DL Programmes	2	3	1	3	8
CAS* & other Concentration or Specialization	0	11	0	3	14
Integrated DL courses in standard LIS or CS programmes	2	18	6	3	29
Number of DL (in total)	4	32	7	8	51

Table 6. Summary of digital libraries programmes or courses with information posted on-line (2005)

No of Institutions	LIS-CILIP	LIS-ALA	CS	LIS-Others	Total No
Detailed course profile or syllabus on-line	0	18	5	4	27
Course plan or simple course description only	4	14	2	4	24
Number of DL (in total)	4	32	7	8	51

3. ANALYSES AND DISCUSSION

3.1 Why Teach DL Topics?

The major reasons for teaching digital library-related topics, from information posted on the web sites studied here and from other sources, can be listed as follows:

3.1.1 Clear Demand for Hiring Digital Librarians in Digital Information Management

It is evident that there is already a shortage of supply, a lack of information professionals with the right combination of skills. The degree of such a shortage varies from time to time and place to place. For example, in the USA, projections indicated that retirements will have an enormous impact on ARL (Association of Research Libraries) libraries over the next 25 years. ALA libraries will be in a similar position [11, 12]. It is particularly serious in specialty areas such as research and academic libraries. It is clear from this that there is the need to educate a new generation of digital librarians.

Nowadays, digital collections and the ability to provide access to these digital resources are playing ever more important roles in every library and information centre. It is reported that many cultural heritage institutions have had good equipment for their digitization projects but many of them did not complete the projects because of the lack of well-qualified professionals who had expertise in digitization. Increasingly, publishers and information professionals in government and commercial enterprises are being faced with the challenges of creating and managing digital resources.

3.1.2 Increasing Demand for Educational DLs
There is no doubt that educational digital libraries are playing an increasingly important role in higher-education, in particular, in distance-learning environments. Nowadays, digital collections and access to them have become an essential component of the educational institutions worldwide, not only for most developed countries, but also in many developing countries.

The Carnegie Corporation of New York [13] reports that one thing in favor of Third World Library users is the rapid advance in digitization technologies. Digital libraries are already starting to deliver information that local libraries in these developing countries could not previously get or afford. It is predictable, indeed already apparent, that there is a serious shortage of well-qualified information professionals in digital resources management around the world.

3.1.3 Increasing Funds Available for DL Education
There was little or no funding for education in digital libraries [1] in the last century. However there are some encouraging changes recently. For example, the Institute of Museum and Library Services (IMLS in the USA) has funded several projects in digital library education as part of their "Librarians for the 21st Century Programme" in late 2004.

Another recent example is that the School of Information Management at Victoria University of Wellington, the only provider of post-graduate library qualifications in New Zealand, and the New Zealand Electronic Text Centre, are jointly applying to an Innovation and Development Fund to create a programme entitled "Certificate in Digital Resources Management". This programme, available also as part of an MLIS degree or in modules suitable for continuing professional development by working librarians, is designed to fill a significant gap in the current tertiary education provision in the New Zealand. It is also aimed to achieve a significant growth in the pool of qualified and skilled professionals able to work in digital resources such as university archives, the national heritage archives project, online publication in government departments and corporates, e-learning initiatives, and regional digitization projects.

3.1.4 Study Results
The results from this current study indicate that the number of institutions offering courses or programmes in digital library education is still growing. In particular, there is a significant increase in the number of institutions with CILIP accredited programmes in the UK and ALA accredited courses in the USA and Canada (see Tables 2 &3). For example, the number of institutions offering programmes / courses in digital library education in total has increased from 40 [3] to 51 in this study. About 70% (36/51) of those courses offered are now from institutions with CILIP or ALA accredited programmes; it was about 58% (23/40), in 2004 [3].

It is notable that there have been some changes in the institutions offering courses in digital libraries. For example, some institutions like Cornel University, University of California at Berkeley and Loughborough University have stopped individual digital library course recently (after Liu's survey, perhaps after 2003). The reasons for that change may vary from place to place. For example, Loughborough University decided to do so as the content of the former DL course has been fully integrated to their standard Master's programmes, in recognition that DL material is moving into 'mainstream' library education.

In summary, there is a growing demand for information professionals specializing in digital information management and increasing provision of courses and programmes. There is consequently a pressing need for educators to develop a clear understanding of the essential components of a programme in digital library education.

3.2 What to Teach About Digital Libraries?
3.2.1 Content & Curriculum Areas
Many educators in digital library education believe that 'defining digital librarianship is a complex area and the knowledge and skills needed to perform digital library jobs are difficult to acquire in the graduate library school curriculum' [1, 2, 7, 14].

In the first survey of digital library education, Spink and Cool [2] analyzed the content in existing digital library programmes and suggested a list of curriculum areas for digital library education. They recommended "an expansion of traditional LIS and Computer Science (CS) curricula to encompass a more general DL track". They also pointed out that such a hybrid curriculum was needed for interdisciplinary collaboration.

Saracevic and Dalbello [1] surveyed digital library education (e.g. curricula and content) further and provided some answers to questions like "what to teach about digital libraries". At that time what to teach was a choice of content that mainly relied on the educator's background- usually library science or computer science. The contents of digital library courses provided by the two sides bore little relation at that time, and were just like two ends of a spectrum. There was little or no funding to develop education in digital libraries. They suggested that digital library education did require an integrated and comprehensive programme and specific attention to its own needs.

In the past decade, some educators have developed significant anecdotal knowledge of what topics are critical to digital library education and what topics are not, but little formal effort has been expended on understanding the knowledge requirement in DL curriculum design or structure [14, 15]. Liu [3] suggested that a curriculum designed for digital libraries should include these areas: history and definitions of digital library, building and organizing digital libraries, integrating and interoperating digital information, policy and legal issues in digital libraries, interface design and services, digital library evaluation, collaboration and global perspectives on digital libraries, and the future of digital libraries in society.

3.2.2 Recommended Courses & Focused Areas

It can be seen from Table 5 that about 43% (22/51) of DL programmes or courses are full independent programmes (as defined in 2.1.3) now. Each DL programme comprises a range of courses covering different aspects of digital libraries.

The students in many institutions are not only required to finish three or four core modules, but also need to pass some elective courses in order to complete their degree or certificate in the DL specialization. Core modules normally consist of fundamentals / introductions to DL or ILS, digital collection or architecture organization, management of services, legal issues, information retrieval and digital library design & management. Elective modules are much more related to research and practical parts in digital libraries, such as a placement or research into DL, metadada for cataloguing and classification, and interfaces to information system and library automation.

An analysis of curricula lists with recommended courses (22 in total) from ten institution offering independent DL programmes is given in reference [10]. It is found that the focused curriculum areas from LIS and CS are still rather different. The one offered by LIS provides a wide range of modules covering many aspects of digital library, such as creating, maintaining, evaluating and legalizing digital libraries. The one from the CS side appears more specialized in computer-concentrated topics related to digital library. But the contents of DL education programme provided from both professional sides do have a degree of commonality. For example, courses such as information storage and retrieval, computer-human interaction and user interface are included in both curricula [10].

3.2.3 Study Results

The results from this study indicate that there has been some improvement in the DL programme design (curriculum structure). There appears a better understanding of what to teach about digital libraries both from LIS and CS educators as the subject nature and a growing range of related courses from other institutions become know and can inform individual educators and course designers.

- *Similarities & differences within the DL courses*

In the last survey prior to this one about digital library education, Liu [3] analyzed the similarities and differences between digital library courses in more detailed areas such as teaching emphases, course outline, indicative textbooks, assignments and projects. A similar analysis has been applied in this study as well. Some similarities and differences between these syllabuses are listed in reference [10].

In generally, the results from this study show a reasonable agreement with Liu's study. However, regarding the question of 'what to teach about digital libraries?' there have been some notable changes. The changes can be summarized as follows:

- Fewer (if any) courses in DL are based on a purely theoretical approach. For example, Simmons and the University of South Florida have included some kind of requirement for project practice in their course grading.
- Many (over half, at least) institutions offer on-line detailed course information, reading and practice resources, and other materials (e.g. assignment or examination aids) for the students registered with them.

- There are increasing relationships in their curricula design and focused curriculum areas in DL courses offered by both LIS and CS. For example, most courses included information storage, access and retrieval, available technologies of metadata and other data formats and standards, as well as interfaces.
- Course information from most institutions are updated regularly, say each academic year.

3.3 How to Teach About Digital Libraries?

It is critical for every successful education programme in DL to have a complete and up-to-date understanding of the skills and knowledge needed to create and manage digital libraries, and to teach students in a systematic and comprehensive way. However, it has been reported that almost every educator was struggling to teach students in such way [14, 16].

3.3.1 Current Status of DL Education

- *The level of faculty in DL education*

From information shown on web sites, most educators in digital library education are well qualified in their professional areas. Most are Professors and/or Ph.D holders, and most of them have had many years experience in DL research and education.

- *The background of students in DL education*

Liu [3] suggested that students who had prior practical experience with digital libraries, and those provided with "hands-on" courses, appear to be best served in their digital library education. It was reported [18] that the Digital Library Education Program (DLEP) Fellowships 2005-2006 at Indiana University and the University of Illinois at Urbana – Champaign have been awarded to ten students based on an IMLS (the Institute of Museum and Library Services) funding entitled 'Recruiting and Educating Digital Librarians for the 21st Century'. These DLEP Fellows come from different backgrounds and are educated to different levels, but they all have particular interests in different aspects of the digital library, such as digital archiving, digital collection, digital preservation and interface design.

However, no comprehensive data on what kind of background of students is required in DL education have yet been published, so comparison of the effect of this on who will be the best candidates for new digital librarians can not be made.

- *Course types, forms and levels*

The present study shows that the type of digital library programme / course varies from institution to institution. About 43% of DL programmes are stand-alone now, mostly clustered in the CAS type of qualification. The rest of them are integrated with existing Master of LIS or CS programmes. Many institutions offer DL courses at different levels. For example, Indiana University offer their DL course not only to the students who enrolled in their digital libraries education programme (DLEP, post-Master level), but also to other Master students in their library school. Some institutions also open their DL concentration course to librarians & information professionals who want to find their career in digital libraries. It is notable that the current digital library education is conducted with students and information professionals at different levels, such as MLIS, MCS, Certificate of Advanced Study, post-Master (double Master degrees holders) and possibly PhD candidates.

3.3.2 What is the Best Way to Teach About Digital Libraries?

This has been a big question to many educators around the world since DL education started from the middle of 1990s. It was the case that many educators hoped to do a good job in this area, but most of them did not have much direct practical experience in digital libraries. There was also the problem with financial support.

Many educators believe that one difficulty in determining the availability of digital library coursework in library schools is the failure to differentiate between courses that focus on *using* digital library content and courses that focus on *creating, maintaining, delivering* and *preserving* digital content [13]. They believe that most such integrated courses largely concentrate on using digital content, and pointed out that it would be difficult for library school staff to incorporate all of the rapidly-evolving digital library technologies in their courses without a close working relationship with practicing digital library professionals. Therefore, they believe a better systematic understanding of practical digital librarianship and its relation to digital librarianship education is needed.

There has been significant progress in the past few years. For example, Indiana University and the University of Illinois at Urbana – Champaign [14] were awarded a grant from IMLS This grant is aimed at "building up an effective digital library curriculum through library school and academic library partnership". This programme is grounded in the needs of the discipline that combines the theoretical orientation of graduate library education with the "real world" of work in academic digital libraries. This project expects to help guide other graduate library schools to determine how to educate students and practicing librarians who are excited about employment opportunities in digital libraries. It has very recently been announced that the National Science Foundation (NSF) in the USA has also awarded a three-year grant of over half a million dollars to Virginia Tech (VT) and the University of North Carolina (UNC) at Chapel Hill to develop a digital library curriculum. The project [18] is titled "Collaborative Research: Curriculum Development: Digital Libraries", and is to be led by academics from CS at VT and LIS at UNC.

Other professional organizations in library education, for example, ALISE (the Association of Library and Information Science Education in the USA) have also recognized such needs in developing the best way to educate digital librarians. ALISE gave two grants to support research related to education in digital librarians in 2005. The educators (one from SUNY Oswego and other one from University of British Columbia) to whom these grants were awarded will focus on digital librarians themselves with questions like, ' Who are they? What skills do they need? And how best to educate them?' [6].

From the results of this study, it is found that most educational institutions have recognized the need for a combination of theoretical knowledge and practical experience in digital library education. Almost every DL course included some degree of hands-on research work in its grading and assignments. Welcome cross-disciplinary and cross-institutional cooperation has emerged in the DL education area.

3.3.3 The Latest Thinking on What is Best Practice in DL Education

In the JCDL05 workshop on DL education [19], many contributors pointed out the need for library educators to work with practitioners in digital libraries to help develop a well-rounded curriculum. There was a recurring theme from this workshop that digital library work is collaborative and that consequently education for this field should be as well. In this workshop, participators discussed the future of digital libraries and related questions about how to teach digital librarians. Many of them saw a trend that digital libraries and digital library projects would move away from stand-alone units to integration with the non-digital libraries (hybrid libraries).

Some presenters mentioned areas in which many digital libraries need more expertise, and pointed out that those should be taught in DL courses. These areas included licensing negotiation, rights management, content follow-through, XSLT (Extensible Style-sheet Language Transformation) and databases, systems administration, personnel and project management, usability and user services, and technical and structural metadata.

It is perhaps a little too early for DL educators to agree fully on the best way to educate digital librarians, and there will always be legitimate differences in content and approach from institution to institution just as there are with other subjects. However, experience and practice related to how to teach about digital libraries are developing rapidly. For example, a survey of needs and skills for digital library practitioners was planned by the University of Illinois at Urbana-Champaign and should have been completed by the end of 2005 [14].

3.3.4 What would be the Best DL Programme?

What would be an optimized structure for a programme in LIS intended for DL education is one aim of this study. Is it best that this should be a specialized programme in its own right or should digital library education be integrated into appropriate parts of a standard library course education programme?

In the JCDL05 workshop on DL education [19], workshop attendees debated the form that the DL education should take. Many attendees were strongly in favor of integrating hands-on training in working digital libraries as part of the curriculum, but others proposed a hybrid curriculum to bring together strengths from diverse departments. However, most agreed that digital library education should include a combination of theoretical knowledge and practical experience [19].

In summary, there is currently no optimized structure for a programme in LIS or CS intended to be for digital library education. But there has been some progress in how to educate digital librarians at individual institutions, and this aspect is continuing to develop rapidly. It is hoped that this questions could be answered definitively in the fairly near future.

4. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

This study indicates:

- The number of institutions offering digital library education is still growing. In particular, about 75% of DL programmes or courses (36/51) are offered by institutions with accredited

programmes or courses from CILIP (22%, 4 /18) in the UK and ALA (64%, 32 /56) in the USA and Canada.

- About 43% of institutions (23 / 51) are offering fully independent DL programmes, across a range of levels – and especially at Certificate level.
- Over half the institutions (27/51) examined here have posted their detailed course syllabus or profile on-line; most of them appear to update regularly.
- There are increasing opportunities for funding to develop new initiatives in digital library education.
- The DL curriculum design and focused teaching areas appear more systematic and comprehensive. Most DL programmes are now based on a combination of theory and practice, and a standard and optimized model of best practice in DL education has not yet emerged, but there is progress in this area.
- Educators in the DL area are working increasingly closely with practitioners in digital library developments. Cross-disciplinary and cross-institutional collaboration on DL curriculum developments has emerged recently.

4.2 Suggestions for Further Work/Research

The following suggestions are based on the findings of this study:

- There should be more opportunities for educators worldwide to share curriculum developments and arrive at a common understanding of core and elective education needs in DL area-through there are still likely to be legitimate differences of emphasis bearing in mind individual institutions' strengths and the background of their students, just as with other types of courses.
- It would be highly beneficial for educators to work more closely with digital library practitioners and share experience with other relevant disciplines.
- A 'standard' digital library educational model is likely to be based on a combination of theoretical knowledge and real working experiences in digital libraries.
- The restricted data collection in this study (see 2.1.3) could usefully be expanded to be more comprehensive. However, its present restricted nature indicates that, if anything, we are under-reporting the increase in institutions offering DL education. A more comprehensive research programme would extend to wider geographical regions, including developing countries, and would also attempt to identify the DL content in Computer Science or other disciplinary – something only partially undertaken in this, or previous studies. This research could also investigate pre-requisites were required. Alongside a web-based survey, it would be instructive to construct a questionnaire to explore key questions, and ideally to follow this up with a number of personal interviews with educationalist, students and practicing librarians.
- However, as can be appreciated from the paragraphs above, a tremendous amount of work would be required and this would most appropriately be undertaken under the auspices of an international body such as IFLA. It is hoped that this might be possible, and that this study would help to form a good basis for it.

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