Penetration and Coverageof It Courses in Lis Education: A Comparative View From Five Continents (Paper ID: 117)

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ABSTRACT

Background. Library and information science (LIS) education faces many challenges in today's society, and one of which is how to infuse information technology (IT) into its curriculum.

Objectives. To explore and compare the penetration and coverage of IT courses in LIS education in different countries in order to shed light on the extent of IT challenges as reflected in the LIS curriculum.

Methods. Curricular data were collected from 155 LIS schools in five continents. Two indexes, the Penetration Index (PI) and Coverage Index (CI) of IT courses

were created. More than 10,000 courses extracted from the curricular data set were also coded using a scheme of 194 categories in 15 classes. All the data were analysed by country/region, program level and course type.

Results. More IT courses with a wider range of subjects are covered in LIS education overall although differences exist with regard to countries/region, program levels and course types. LIS schools in five continents have been adopting an open and proactive approach to infusing IT courses, greater in number and variety, into their LIS curricula. The penetration and coverage of IT courses in LIS education depend on not only the good will of LIS educators but also to a large extent the IT development status in the home country/region of LIS schools. The latter actually is a prerequisite for the former to take place. Other parameters such as program level and course type also play a role in determining the impact of IT courses on LIS education.

Contributions. A new technique using the PI and CI indexes is developed in this research to explore the penetration and coverage of IT courses in LIS education. This study also analyses and compares the impact of IT courses on LIS education with data collected from LIS schools in five continents, a scale few prior studies ever attempted. In addition, the findings of this research would help LIS educators, professionals and administrators to be better positioned and prepared in meeting the IT challenges in LIS education.

INTRODUCTION

Social and technology challenges are always addressed as fundamental driving forces for curricular innovations (Gadner, 1987; Van House & Sulton, 1996). As information technology (IT) applications are mushrooming in the information society, the role of IT courses in library and information science (LIS) education gradually changes from auxiliary knowledge to core mission and thinking (Latham, 2002).

Applying information technology in library operations and services could be traced to the use of magnetic storage technology in the 1940s. About two decades later, quite a number of IT courses were introduced into library schools to cover subjects such as computing and audio-visual materials (Asheim, 1968; Schick, 1968). When information science was brought into the traditional field of library science in the 1970s (Borko, 1970; Hayes, 1969; Wilkie, 1971), IT courses offered in library schools increased greatly both in number and content coverage (Belzer, Issac, Finkelstein & Williams, 1971; Belzer, Williams, Kronebusch & Gupta, 1975; Fosdick, 1978). Some of them were even designated as core courses in library schools (Bidlack, 1977; Jahoda, 1970).

When the sharp shrinking of library schools in number occurred in the 1980s, the LIS curriculum was scrutinized again and dated courses were identified as one of the reasons of library school closing (Dyer & O'Connor, 1985; White, 1986). In response to the challenge, more IT courses were infused into the existing LIS curriculum (Paris, 1988; Woodsworth, 1994). Some LIS educators and professionals (e.g., Cooper & Lunin, 1989) maintained that there was a natural convergence of library science and related fields. A broader approach should be taken to expand library science to include information science and other related fields (Cronin, 1982). It was at that point when many library schools started including "information" or "information science" in their names to become LIS schools while seeking collaboration with other disciplines such as computer science and management of information systems. People with Ph.D. degrees from those disciplines were also recruited as LIS faculty to teach IT courses (Robbins, 1993; Steig, 1992; Van der Starre, 1993).

When the KALIPER (Kellogg-ALISE Information Professions and Education Reform) project was conducted to examine the development of LIS education in North America, Pettigrew and Durrance (2001) found that LIS curricula mostly addressed broad-based information environments and problems. The authors pointed out that the infusion of IT courses into LIS curricula should not be simply regarded as a short-term act. Rather a long-time commitment ought to be made to redefine LIS curricula with IT courses. In addition, many (Cox, 2010; Dillon & Norris, 2005; Gorman, 2004; Stoffle & Leeder, 2005) indicated that IT would be a required component in LIS education.

In the past decades, heated debates were made regarding how and to what extent IT courses should be infused into LIS education (Dillon & Norris, 2005; Gorman, 2004; Grealy & Hall-Ellis, 2009). Even today, the debate is still on and LIS educators all over the world continue seeking better answers to the debated questions in various contexts. The current study aims to compare IT course coverage and penetration in LIS education with data collected from 155 LIS schools in five continents.

LITERATURE REVIEW

A good number of studies have attempted to evaluate the importance of IT courses in LIS curricula in the past decades. For instance, Belzer, Williams, Kronebusch and Gupta (1975) compared the curricula of LIS schools from 1968 to 1972 and identified 13 typical IT course topics. Fosdick (1978) did a similar study, reporting that 85% of LIS schools offered courses in "Library Automation", 95% "Information Storage and Retrieval", 62% "Systems Design", 65% "Information Systems Interaction", and 38% "Programming". Although the findings by Fosdick (1978) were encouraging then, researchers in recent decades are concerned about the structure of such courses and their coverage of new IT topics in LIS education.

After examining the course offerings by 55 ALA-accredited MLIS programs, Markey (2004) found that the number of IT courses offered and required in those programs increased dramatically and so did the number of faculty with IT background to teach them. New topics such as community information system, competitive intelligence, computer-supported collaborative work, electronic commerce, human-computer interaction, information architecture, information design, knowledge management, medical informatics, and natural language processing are added to existing curricula. However, the core curriculum at that time remains to be made up by courses on LIS foundation, references, knowledge organization, and management. The finding Markey (2004) reported regarding the composition of core courses was echoed in Hall (2009) who explored the core courses across almost all ALA-accredited MLIS programs. The focus of the core appeared shifting from references to research methods and information technology.

Riley-Huff and Rholes (2011) identified 439 technology-related courses in 15 categories from the curricula of 57 ALA-accredited MLIS programs in North America. Despite an increase in IT course offerings in their curricula, graduates from those programs were not adequately equipped with IT knowledge and skills to assume major technology roles in academic libraries. Based on an analysis of the 1712 courses sampled from the 2013-2014 curricula of the top 14 LIS schools in North America, Sharon Hu (2013) stated that about one-third (519) of them were IT courses. The author also indicated that the impact of IT on LIS curricula could be found in new course creation, new composition of the IT course cluster, and new IT career opportunities for LIS graduates. Yi and Turner (2014) did a similar study with a data set of 1150 courses gathered from 84 master's programs for school libraries and confirmed that technology became a major subject across all such programs. The "information systems and retrieval" area, representing IT courses, had a strong presence in their curricula.

Another related issue researchers tried to address over the decades was whether the LIS curriculum had an IT core. Beheshti (1999), in analyzing the titles and descriptions of 3085 courses 44 ALA-accredited MLIS programs offered in 1998, extracted over 500 terms representing 57 major concepts covered in their curricula. Those concepts were then measured by frequency-based intensity. The author concluded: "while many traditional concepts are still intensely covered, LIS programs are gradually increasing their coverage of newer concepts, particularly technology and related topics." (p. 1) Using a much smaller sample than Behashiti (1999), He (1999) performed a content analysis of IT courses taught in four American LIS schools in six academic years (i.e., 1971-72, 1975-76, 1980-81, 1985-86, 1990-91 and 1994-95), reporting that there was a common set of seven IT courses in their curricula. Those courses were Database Systems/DBMS, Information Storage and Retrieval, Information Systems, Library Automation, Management of Information Systems, Multimedia,

Online Library Systems/Catalogs. Both Behashiti (1999) and He (1999) tend to suggest that there is a core of IT courses in the LIS curriculum.

In addition to the IT core in LIS curricula, researchers are concerned if changes or enhancements made to the LIS curriculum are mostly IT related. Tracking the 695 new courses added to LIS curricula from 1988 to 1998 based on the ALISE statistic reports, Callison and Tilley (2001) observed that IT was one of the most important areas where new courses were introduced. Chu (2006) performed a content analysis of 2,757 courses offered by 45 ALA-accredited MLIS programs in the USA. Most of the 292 new courses were IT related with the top five new course cluster labels as follows: "digital libraries", "website design, web applications", "computer/information/Internet networks", "digitization, digital preservation/design", and "information architecture". The author contributed the mushrooming of IT courses in the LIS curriculum to the advent of the Internet and other IT developments as well as their applications in the LIS field.

As shown in the review above, IT courses in LIS education have increased in both number and content. In some LIS schools, IT courses become one of the core areas (Behashiti, 1999; He, 1999) while others attempt to infuse new IT courses into their curricula on a regular basis (Callison & Tilley, 2001; Chu, 2006). But do IT courses constitute the required competencies or skills in LIS education? According to McKinney (2006), 66.1% of the ALA-accredited MLIS programs claimed that technology coverage should be one core competency in the curriculum, which was ranked the sixth in all the knowledge areas. Among the 12 required categories of skills obtained from the 58 ALA-accredited MLIS programs' websites, Scripps-Hoekstra, Carroll and Fotis (2013) found that courses on word processing, presentation, file management, and the Internet received the highest frequency of coverage. All of such courses are IT oriented.

Previous research addresses many issues with regard to IT courses in LIS curricula. However, few studies explore the penetration and coverage of IT courses in LIS education, let along from a multi-continent perspective. The current research thus intends to examine the penetration and coverage of IT courses in LIS curricula with 10,486 courses collected from 155 LIS schools in Australia, Canada, China (both Mainland and Taiwan), South Africa, UK, and USA. The following three research questions are to be addressed in this study:

1. To what extent have IT courses been penetrated and covered in the LIS education in the selected countries/region?
2. Does IT have different impacts, measured in penetration and coverage of IT courses, on LIS education by country/region, program level and course type?
3. Are similar IT subjects covered in LIS education in the countries/region selected for this study?

RESEARCH METHEDOLOGY

Data Collection

According to the statistics UNESCO collected, there are around 900 LIS schools in the world (Schniederjürgen, 2007). A total of 155 LIS schools in seven English and Chinese speaking countries/region were selected for this study. The websites of those schools were visited in the last quarter of 2015 to manually collect all accessible curricular information. The LIS school and course frequency distributions by country/region in the data collected are presented in Table 1.

It must be pointed out that only courses listed in the LIS curriculum were collected in this research, excluding any one-time lectures or workshops. Courses with a same course number but significantly different titles or courses with a same course title but different course numbers were coded as two different courses. This definition for courses reduced the total number of courses from 13, 719 to 10486, which constitutes the data set for the present study.

Table 1. Frequency Distribution of LIS Schools & Courses by Country/Region

Country/Region	LIS School	Course
Australia	17	917
Canada	8	764
Mainland, China	50	3584
South Africa	7	458
Taiwan, China	9	823
UK	15	779
USA	49	6394
Total:	155	13,719

Coding and Categorizing Course Data

The ALISE LIS Research Classification Scheme[15] contains 104 categories in 10 classes of subjects in library and information science. Although the scheme is not designed for categorizing LIS courses, it is perhaps the only one that is published by an organization in our field on a scale that suits the current study. The initial coding of our course data with the scheme however turned out that only 57% of the 10486 could be adequately placed into the 104 categories in the scheme. In order to code all the course data we collected, we expanded the ALISE scheme in the following three steps.

[15] See http://www.alise.org/index.php?option=com_content&view=article&id=487.

Step 1: Open coded the remaining 47% of the courses and generated 324 temporary course categories.

Step 2: Cross checked the newly generated 324 individual categories by merging the similar and removing the redundant, reducing the total number of new categories down to 90.

Step 3: Integrated the 90 new categories into the scheme. The extended LIS classification scheme has 194 categories in 15 classes. Of the 194 categories in the extended ALISE classification scheme, 64 are designated for coding IT courses. Table 2 lists all of them.

Table 2. IT Categories in the Extended ALISE Classification Scheme

AI & BI	e-Business	Information Preservation	Multimedia Technology
Applications & IT Service in LIS	e-Government	Information Processing	Music/MultiVedio
Coding & Programming	e-Learning	Information Representation	New Literacies
Computer/Information Networks	Electronic Documents/Digital Content	Info Retrieval Theory & Practice	NLP & Semantic Analysis
Data Mining	Electronic Reference Services	Information Seek/Access	Online Retrieval Systems
Data Process/Data Management	Emerging Tech: Cloud Computing & Big Data	Information Sharing	Organization of Information
Data Resources Management	e-Publishing	Info Systems & Technologies	Project Management
Database/Technology of	Human-Computer Interaction	Information Visualization	Search Engine
Database & Other IR Systems	Informatics/Information Management	Information/Data Analysis	Social Software Applications
Digital Archive Informatics	Information Architecture	IT in Education	Social/Community Informatics
Digital Curation	Information Digitalization	IT Issues in Archive	System/Website Design & Analysis
Digital Humanity/Social Computing	Information Generation	Knowledge/Software Engineering	Tagging & Folksonomy
Digital Records Management	Information Immigration	Knowledge/IR Management	Technical Issues in Info Retrieval
Digital/Virtual Libraries	Information Integrity & Security	Library 2.0/3.0/Future	Users & Uses of Info Systems
Digital Resources & Licensing	Info Management & Governance	Metadata & Semantic Web/Ontology	Web/Internet Resources
DSS	Information Planning	MIS & Info Management System	
		Mobile Networks/Wifi	

There are different kinds of courses in the LIS curriculum, which can be summarized into three major types: required, recommended, and elective. Furthermore, there are many synonyms for each of the three types of courses (see Table 3). We chose the terms in the most left column in our coding process.

Table 3. Synonyms Used for Each Course Types	
Course Type	**Synonym**
Required	Compulsory, Core, Common, Central, Foundation, General, Introductory, Leading, Major, Overview, Supportive, General Education, Platform, Main, Core Units, Prescribed Units, Class A, Class B, …
Recommended	Highly Recommended, Guided Electives, Professional, Special Electives, Specialization, Supervisor Recommended, Class C, …
Elective	Electives, Selective, Optional, Sub-major, Suggested Electives, Class D, …

Similar to the case in naming course types, LIS schools in the chosen countries/region also have different names for their degree and certificate programs (see Table 4).

Table 4. Synonyms Used for Program Levels	
Program Level	**Synonym**
Bachelor	Undergraduate, Honours,
Master's	Professional Master's, Research Master's, MLIS, MLS, MLIM, Postgraduate
Ph.D.	Doctoral, Ph.D., Post-Master's
Certificate/Diploma	Certificate I, Certificate II, Certificate III, Certificate IV, Graduate Certificate, Advanced Certificate, Advanced Diploma, Graduate Diploma, Post High School Diploma

The variations in program levels do pose some challenges to our data coding. We again chose the terms in the most left column for coding purpose. The coding task was accomplished using a semi-automatic mechanism in Excel 2010 by two authors of this writing. Cohen's kappa for the inter-coder agreement is 95% at the program level or for course types, exceeding the acceptable-to-all rate of 90% (Neuendorf, 2002, p. 143) stated. As for the coding course categories, the inter-coder agreement again measured in Cohen's kappa reaches 83%, which surpasses the acceptable-to-most rate of 80% (Neuendorf, 2002, p. 143).

IT Penetration and Coverage Indexes

Two indexes, penetration and coverage indexes for IT courses, are developed in this study to measure the position and extent of IT courses in the LIS curricula of the chosen LIS schools.

The IT Penetration Index (PI) is defined as the percentage of IT courses in all courses offered. That is:

$$PI = \frac{N_{IT}}{N_{ALL}} * 100\%$$

Where N_{IT} is the number of IT courses in the curriculum, and N_{ALL} represents the total number of LIS courses. Therefore, the larger the PI value is, the more importance position IT courses hold in the LIS curriculum.

The IT Coverage Index (CI) is defined as percentage of IT course diversity (in terms of IT categories) in all the IT course categories of this study (see Table 2). That is:

$$CI = \frac{M_{IT}}{M_{ALL}} * 100\%$$

Where M_{IT} is the number of IT categories the LIS curriculum covers and M_{ALL} means the 64 IT categories listed in Table 2. Therefore, the larger the CI value is, the wider coverage the IT courses or categories have in the LIS curriculum. We will present and discuss below the PI and CI values by course type, program level as well as LIS curriculum. All these would be done at the aggregated level of country/region.

RESULTS AND DISCUSSION

Penetration and Coverage of IT Courses in LIS Education

As explained earlier, we created two indexes to measure the penetration and coverage of IT courses in LIS schools in six countries and one region (i.e., Taiwan, China). Table 5 shows the PI and CI values of IT courses in LIS curricula by country/region.

Table 5. PI & CI of IT Courses in LIS Curricula by Country/Region

	USA	CAN	UK	AUS	CHN	RSA	TWN	IT-Total
PI	33.0%	27.8%	34.6%	36.5%	**41.8%**	23.1%	39.4%	35.3%
CI	**93.8%**	70.3%	67.2%	67.2%	73.4%	31.3%	67.2%	100%
IT Courses	1692	186	150	185	1139	76	277	3705
Total Courses	5122	669	434	507	2722	329	703	10486
Total Subjects	60	45	43	43	47	20	43	64

Of the 10,486 courses coded in this study, 3705 belong to the IT type which translates into a PI value of 35.3%. Compared with the 30.3% of IT course ratio reported in Hu (2013) and 23.4% in Beheshti (1999), the outcome of this study appears increased in value. At the country/region level, China achieves the highest PI (i.e., 41.8%) among all selected, reflecting the open and pro-IT approach China takes in its LIS education. Both Australia and Taiwan, China also outperform other parties in their PI values.

As far as CI is concerned, USA leads the rest with a 93.8% of CI in covering the widest variety of IT course categories (i.e., 60 out of the 64 total) in its LIS education. All other countries/region fall behind by at least a CI value of 20%. This finding indicates USA is not only the leader in the IT world but also the leader in offering IT courses in LIS education. IT course offerings both in quantity and variety in the LIS curriculum to a certain extent reflect a country's development in the IT area. For this reason, the PI as well as CI values of IT courses for South Africa situate at the lower end of the measurement spectrum.

In addition to the CI values reported in Table 5 for each country/region, the top six categories of IT courses in the data set the current study analysed are: Information Systems and Technologies, Computer/Information Networks, Knowledge/Information Resource Management, Coding and Programming, System and Website Design/Analysis, and Database. These six IT categories account for nearly 13% of all the courses coded. Of the six top categories of IT courses, some (e.g., Information Systems and Technologies) seem to be hot topics across the selected countries/region. Although courses in Computer/Information Networks or Coding and Programming tend to be taught more in China, USA offer more courses relating to System and Website Design/Analysis.

In the coding process of this study, all courses in the LIS curriculum are categorized as required, recommended and elective courses. Table 6 demonstrates the penetration and coverage of IT courses by LIS course types in the chosen countries/region.

Table 6. PI & CI of IT Courses by LIS Course Types

	USA	CAN	UK	AUS	CHN	RSA	TWN	All-Region
Required Courses PI	**38%**	23.7%	**41%**	34.7%	**41.9%**	27%	28.7%	38.1%
Recommended Courses PI	32.5%	0%	0%	0%	**46.7%**	0%	28.6%	39.5%
Elective Courses PI	30.5%	28.7%	26.1%	**38.3%**	**43.6%**	21.6%	**41.3%**	32.6%
Required Courses CI	76.6%	7.8%	50%	48.4%	57.8%	23.4%	32.8%	90.6%
Recommended Courses CI	40.6%	0%	0%	0%	40.6%	0%	3.1%	60.9%
Elective Courses CI	15.6%	0%	0%	9.4%	15.6%	0%	0%	34.4%

A quick glance of Table 6 reveals that PI values of IT courses appear similar for both required and elective offerings. In contrast, CI values for required courses apparently exceed that for electives. This finding indicates that all LIS schools place an emphasis on the variety of IT courses in their required courses. Electives cannot reach that level of CI value because those courses are all supposed to specialize in one or more topic areas instead of a broad coverage of many as done in required offerings.

Table 7 displays PI and CI values of IT courses at different program levels of LIS education among the six countries and one region. Overall, master's program level courses in most countries/region have the highest PI values because the MLIS program in LIS schools in English-speaking countries offers a professional degree which must incorporate adequate IT courses in order to prepare students to work in IT-rich environments. Undergraduate programs in the USA and China do well in terms of IT courses offerings based on the PI values. This can be explained by the fact that the undergraduate program in the USA is designed to have an IT orientation although it is housed in the LIS schools. Its graduates typically work in IT companies and the IT sector of many organizations/institutions. China's undergraduate program in LIS in comparison has a much longer history. In recent decade, the undergraduate curriculum in LIS schools leans more and more towards the IT domain in order to attract more applicants to their programs as well as enhance the placement rate for their graduates. The Ph.D. program in any of the selected countries/region is research oriented. Thus it is not surprising to see that the PI values for all the countries/region are smaller than those for the master's or undergraduate programs. It would however have been surprising if IT courses had been found to make up a large portion of the research degree program.

Table 7. PI & CI of IT Courses at Program Level by Country/Region

Index	Program Level	USA	CAN	UK	AUS	CHN	RSA	TWN	IT-Total
PI	PhD	21.7%	20.8 %	33.3 %	3.6%	24%	0%	29.8 %	21.8%
	Master's	32%	28.7 %	33.6 %	**50%**	**43.3 %**	31.6 %	**40.5 %**	34.9%
	Bachelor	**48%**	0%	38.4 %	21.2 %	**41.9 %**	18.4 %	36.5 %	**40.1%**
	Certificate	0%	0%	0%	33%	0%	28.6 %	0%	35.3%
CI	PhD	**46.9%**	15.6 %	1.6%	1.6%	21.8 %	0%	17.2 %	59.4%
	Master	**93.8%**	**70.3 %**	**59.4 %**	**59.4 %**	**67.2 %**	17.2 %	46.9 %	**96.9%**
	Bachelor	**70.3%**	0%	34.4 %	26.6 %	**62.5 %**	21.9 %	**57.8 %**	**90.6%**
	Certificate	0%	0%	0%	46.9 %	4.7%	1.6%	0%	50%

Similar explanations can be offered to the CI values of IT courses for programs at different levels with the exception of the Ph.D. program in the USA. One possible reason is that Ph.D. programs in that country in recent decades increasingly become interdisciplinary and computer science in many cases dominates the interdisciplinary make-up of the doctoral

curriculum. The USA also gets the highest CI value of IT courses for its master's programs although, as discussed earlier, its PI value is lower than that for other countries/region. This result can be readily supported by the wider range of IT courses USA LIS schools offer, which is in accordance with the great variety of technology developments made in that country. South Africa, compared with other parties selected for this study, seems weak in CI due to the fact that it is not yet a country with a robust IT environment. IT courses in its LIS curriculum consequently cannot yield a good value in either PI or CI.

All the results and discussion in this section show that penetration and coverage of IT courses in LIS curricula across the six countries and one region are uneven in all the three dimensions (i.e., the LIS schools, course types, and program levels) the present study surveys. The IT developments in a country or region significant affect the PI as well as CI values of IT courses in its LIS education. That is, the penetration and coverage of IT courses would be decent if the country (e.g., the USA) is strong in information technology. Otherwise, the LIS education in the country (e.g., South Africa) will suffer in terms of IT course penetration and coverage in its LIS education. Factors such as program levels also play a role in shaping up the PI and TI values of IT courses in LIS curricula. For example, the undergraduate program could have a designated IT orientation in the first place while the Ph.D. program usually places its focus on research rather than on information technology.

IT Impact Differences on LIS Education

After exploring the penetration and coverage of IT courses in LIS education, we also intend to compare IT impact differences on LIS education in terms of the three parameters of LIS education (i.e., countries/region, program levels, course types) we examined in this study using the PI and CI values presented in the previous section. In other words, IT impact on LIS education is measured by PI and CI values. ANOVA analyses among the three groups of PI and CI data were performed and corresponding results in the form of hypothesis testing are displayed in Table 8.

Table 8. ANOVA Analysis of PI or CI Distributions

Compared Groups		F-Value	p-Value	Significance	Results
Country/Region	→Program Level PI	4.528	0.010	**p<0.05**	Accepted
	→Courses Type PI	3.514	0.048	**p<0.05**	Accepted
	→Program Level CI	0.878	0.528	p>0.05	Rejected
	→Courses Type CI	1.478	0.255	p>0.05	Rejected
Courses Type	→Country/Region PI	3.098	0.070	p>0.05	Rejected
	→Country/Region CI	5.576	0.013	**p<0.05**	Accepted

Program Level	→Country/Region PI	5.826	0.004	**p<0.05**	Accepted
	→Country/Region CI	8.733	0.000	**p<0.01**	Accepted

As shown in Table 8, IT course penetration in LIS education is significantly different in both course types and at program levels among all the six countries and one region while the same does not hold true in terms of IT course coverage. In the case of country/region, IT course penetration differs in the three course types (i.e., required, recommended, and elective) whereas the same is not confirmed in the ANOVA analyses with regard to IT course coverage in LIS education. All the selected countries/region exhibit significant differences in their IT course penetration and coverage at each program levels. It thus seems obvious that no uniform conclusion can be drawn on IT impact differences on LIS education with regard to countries/region, program levels, and course types.

Similarity Analysis of IT Course Categories in LIS Education

Are similar IT subjects covered in LIS education in the countries/region selected for this study? This is the third and last research question this study posed in which IT subjects refer to the 64 IT course categories presented in Table 2. In order to address this question, we conducted a similarity analysis of IT course categories included in LIS education of the selected countries/region by treating every country/region as a variable in the matrix (see Table 9). As the matrix is symmetric, only half of it is presented below. The Pearson's coefficients are calculated based on the number of IT course categories each country/region covers in its LIS education.

Table 9. Similarity Analysis of IT Course Categories by Country/Region

	USA	CAN	UK	AUS	CHN	RSA	TWN
USA	1						
CAN	.719**	1					
UK	.636**	.672**	1				
AUS	.581**	.599**	.492**	1			
CHN	.606**	.489**	.572**	.490**	1		
RSA	.530**	.576**	.640**	.407**	.685**	1	
TWN	.735**	.627**	.560**	.401**	.680**	.612**	1

* P<0.05, ** P<0.01

Table 9 demonstrates that all the selected countries/region are moderately or highly related in the kinds of IT course categories covered in their curricula, implying that similar sets of IT course categories are incorporated in their LIS education. Although this topic is

briefly mentioned when presenting the top six common IT course categories found in all the courses gathered for this study, the current finding further ascertains that all the selected countries/region share the same goal of infusing information technology into LIS education. More specifically, LIS schools in those countries/region have identified a similar set of IT subjects to include in their curricula.

Moreover, the same finding is confirmed in Figure 1 which visualizes the relationship among the six countries and one region via the PI and CI lenses.

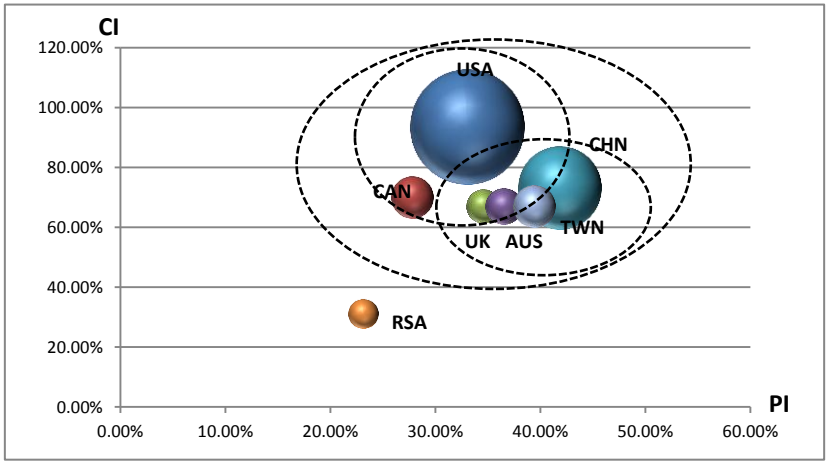

Figure 1. Visualization of Selected Countries/Region via PI & CI Data

In Figure 1 all the countries/region appear related to each other except South Africa. If we regard the six countries and one region as an LIS education galaxy, which includes one single planet of South Africa and two star systems of other countries/region. One star system comprises USA and Canada while the other is composed of China, Australia and UK. Geographically speaking, USA and Canada both are located in North America. South African does have a quite a distance from other countries/region. China, Australia and UK form the other cluster on the map even though UK and Australia belong to two different continents than Asia.

CONCLUSIONS

This study introduced a new technique (i.e., PI and CI) to measure and to compare the penetration and coverage of IT courses in LIS education with data collected from 155 LIS schools in five continents. Although the findings of this research show that differences of IT course offerings exist in LIS education with regard to countries/region, program levels and course types, it is apparent that all LIS schools chosen for this study have been adopting an open and proactive approach to infusing more IT courses with a wider range of subjects into their curricula.

The penetration and coverage of IT courses in LIS education, as shown in this report, depend on not only the good will of LIS educators but also to a great extent the IT development status of the country/region where the LIS school resides. The latter in fact is a prerequisite for the former to take place. Other parameters such as program level and course type also play a role in determining the penetration and coverage of IT courses in LIS education.

This research sheds some light on the impact of IT courses on LIS education, measured by the penetration and coverage indexes, and presented aggregately by country/region, program level, and course type. LIS educators, professionals and administrators should all benefit from the findings of this study so that they would be better positioned and prepared in meeting IT challenges in LIS education. Further investigations in this area have been planned to look into topics such as coverage of IT subjects at the course level and by individual LIS schools. The limitations of the current project (e.g., using the ALISE research classification scheme for coding course data) will also be overcome in our future scholarly endeavours in LIS education.

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