Mapping the Knowledge Covered by Library Classification Systems

Chaim Zins
Knowledge Mapping Research, Jerusalem, Israel and Visiting Professor at the Information Science Post-Graduate Program, Faculdade de Filosofia e Ciências, UNESP – Univ Estadual Paulista. Marília, Sao Paulo, Brazil.

Plácida L.V.A.C. Santos
Professor at the Information Science Post-Graduate Program, Faculdade de Filosofia e Ciências, UNESP – Univ Estadual Paulista, Marília, Sao Paulo, Brazil.

This study explores, in 3 steps, how the 3 main library classification systems, the Library of Congress Classification, the Dewey Decimal Classification, and the Universal Decimal Classification, cover human knowledge. First, we mapped the knowledge covered by the 3 systems. We used the "10 Pillars of Knowledge: Map of Human Knowledge," which comprises 10 pillars, as an evaluative model. We mapped all the subject-based classes and subclasses that are part of the first 2 levels of the 3 hierarchical structures. Then, we zoomed into each of the 10 pillars and analyzed how the three systems cover the 10 knowledge domains. Finally, we focused on the 3 library systems. Based on the way each one of them covers the 10 knowledge domains, it is evident that they failed to adequately and systematically present contemporary human knowledge. They are unsystematic and biased, and, at the top 2 levels of the hierarchical structures, they are incomplete.

Introduction

Human knowledge is growing as we conquer new horizons. New fields emerge as we conceive innovative ideas, improve our scientific methods, and invent new technologies. As a result of this dynamic progress, old books are revised and new books are written. Our libraries preserve and accumulate knowledge.

The concept of "human knowledge" has two distinct yet interrelated meanings. One refers to the subjective domain, and the other refers to the universal domain. "Knowledge" in the subjective domain stands for thoughts in the mind of the individual knower—thoughts that can be characterized as justified true beliefs. "Knowledge" in the universal domain stands for the accumulated and collective discoveries and thoughts of mankind throughout history—discoveries and thoughts that have been represented, recorded, and documented in textual documents (Zins, 2007). Generally speaking, human knowledge in the universal domain can be characterized as the whole collection of textual documents stored in our libraries. This refers to all types of libraries (i.e., traditional and digital, public and private) and all types of media (i.e., published and digital, visual and vocal). In this article, we focus on knowledge and knowledge structures in the universal domain.

The overwhelming quantity of knowledge requires structuring. Knowledge structuring is necessary for meeting two essential challenges: facilitating an efficient retrieval of the stored contents by providing logical access points, and facilitating a better understanding of the structure of the knowledge domain and the logical relations among its main parts.

Cognitive maps are essential for learning and using knowledge (Zins, 2004). The published knowledge maps, structures, and models to which we are exposed affect our cognitive maps and, thus, shape the way we perceive the world and act in it (Zins, 2004, 2006, 2007). For this very reason, we expect that the knowledge maps that we see in libraries, museums, books, and Web sites are comprehensive and systematic.

We are surrounded by numerous published knowledge maps, structures, and models. We encounter them in library classification systems, encyclopedias, Internet directories, textbooks, and the like. In fact, any introductory book of any field of knowledge presents in its table of contents a knowledge map of the relevant field. Tables of contents reflect the

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authors' maps of the fields, and they help to shape the readers' cognitive maps.

Throughout history scholars have tried to structure human knowledge (see, for example, Descartes, Bacon, Locke, and Leibniz, in Burke, 2000). Among the recent models is "10 Pillars of Knowledge: Map of Human Knowledge," which is a systematic and comprehensive map of contemporary human knowledge (Zins, 2008, 2009), and was used in this study as the evaluative model.

In the realm of academic and public libraries, there are three main classification systems: the Library of Congress Classification (LCC), the Dewey Decimal Classification (DDC), and the Universal Decimal Classification (UDC). Do these library classification systems, which are utilized in tens of thousands of libraries worldwide, adequately and systematically cover contemporary human knowledge?

Traditional and digital informational environments include knowledge structured in formats that go beyond the structures implemented by the three systems. This is the raison d'être for this comparative study, which evaluates and compares the three main classification tools adopted by libraries and the 10 Pillars of Knowledge, which reflects the way we, the researchers, conceive the structure of contemporary human knowledge.

Methodology

The study comprised the following three steps. First, we mapped the knowledge covered by the three main systems, LCC, DDC, and UDC. We used the 10 Pillars of Knowledge tree as an evaluative model. We mapped all the subject-based classes and subclasses that are part of the first two levels of the LCC, DDC, and UDC hierarchical structures, for a total of 41 classes and 386 subclasses: 21 LCC main classes (1st level) and 216 LCC main subclasses (2nd level); 10 DDC main classes and 100 DDC main subclasses; and 10 UDC main classes and 70 UDC main subclasses. To be precise, we placed all 41 classes and 386 subclasses of LCC, DDC, and UDC (listed in the Appendix) in the relevant categories of the 10 Pillar hierarchical model.

Generally, we focused on the first two levels of the hierarchical structures of LCC, DDC, and UDC. However, in a few cases, we found it necessary to relate also to the third level of the hierarchical structure, for example, LCC's BF and BL subclasses.

We focus on subject-based classes in this study. We left out other types of classes that are not associated with specific subjects. For example, we left out reference-based classes (e.g., Dewey classes 010 bibliographies, 030 encyclopedias and books of facts, 050 magazines, journals, and serials, 080 quotations, and 090 manuscripts and rare books) and object based classes (e.g., Dewey classes 060 associations, organizations, and museums. Note, however, that class 060 is also associated with the field of museology).

For the raw material, we used the September 20th 2008 versions that appeared on the official Web sites of the three affiliated bodies: the Library of Congress Classification outline from the Library of Congress (www.loc.gov/catdir/cpso/lcco); the Dewey Decimal Classification summaries from the Online Computer Library Center (OCLC; http://www.oclc.org/ dewey/resources/summaries/default.htm); and the outline of UDC from the Universal Decimal Classification (www. udcc.org/outline/outline.htm).

Then, based on the mapping, we zoomed into the 10 pillars and analyzed how each of the three systems covers the 10 knowledge domains. Finally, we focused on the three library systems. Based on the way each one of them covers the 10 knowledge domains, we formulated grounded conclusions on its overall representation of human knowledge.

Evaluative Model: 10 Pillars of Knowledge

The 10 Pillars of Knowledge tree was used as an evaluative model and established the groundwork for the comparative mapping study. The 10 Pillars of Knowledge is a hierarchical knowledge tree. The map has different editions and different levels of abstraction. The edition we used for the study was published in May 2008 (Zins, 2008, 2009; http://www.success.co.il/knowledge/map/map/html) and comprises 10 main parts, or pillars, which are the first-level categories of the hierarchical structure (1st level). The 10 main categories are respectively divided into 32 main subcategories (2nd level). The 32 categories are respectively divided into 30 subcategories (3rd level categories). One of them (category 7.3.1) is further divided into four subcategories, which form the fourth level of the hierarchy (4th level). The four-level structure comprises 76 categories and subcategories. The 76 categories partly overlap, forming 55 unique subject categories. The 55 categories are mutually exclusive and collectively cover the broad spectrum of human knowledge in the universal domain (see the Discussion and Conclusions section).

The 10 Pillars of Knowledge is a systematic map of human knowledge, which presents, at a glance, the structure of knowledge and the meaningful relations among the main fields. Human knowledge comprises 10 pillars: foundations, supernatural, matter and energy, space and earth, nonhuman organisms, body and mind, society, thought and art, technology, and history. The pillars are defined as follows:

- Foundations is the study of human knowledge.
- Supernatural concerns mysticism and religion.
- Matter and energy explores the basics of the physical world.
- Space and earth explores our planet and outer space.
- Nonhuman organisms explores the nonhuman living world, or fauna and flora.
- Body and mind is focused on the human body and mind.
- Society deals with the various aspects of human social life.
- Thought and art studies the products of the human intellect and the arts.
- Technology explores the products of human creativity, which are designed to achieve practical aims.
- History encompasses human history.

The 10 pillars are organized into four groups, which explore four general phenomena: knowledge (pillar 1),

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supernatural (pillar 2), universe (pillars 3–5), and humans (pillars 6–10). From cultural and religious perspectives, nonhuman organisms (pillar 5) and body and mind (pillar 6) belong to different phenomena. Nonhuman organisms is part of the universe, while body and mind is part of humanity. However, from a scientific perspective, nonhuman organisms and body and mind are interrelated; they are part of the same general phenomenon, the living world.

Every pillar comprises relevant categories. Every category presents the relevant fields. For example, matter and energy comprises three main categories: theory, principles, and substances. The theory category comprises two fields: philosophy of physics and philosophy of space and time. The principles category presents physics, and the substances category presents chemistry. The distinction between categories of the map and fields of knowledge is essential.

Human knowledge follows a theory-embodiment structure, implemented within the map level, the pillar level, and the field level. At the map level, pillar 1 is the "theory" part of human knowledge and pillars 2 through 10 are the "embodiment" part. Pillar 1 includes the meta-knowledge (i.e., knowledge about knowledge), or rather the "theory" of human knowledge. Pillars 2-10 embody our knowledge of the supernatural, the universe, and human phenomena, which are the center of human exploration.

At the pillar level, the first category, theory, is the "theoretical" part of the pillar, which presents fields that focus on the theoretical aspects of the explored phenomena (e.g., philosophy of knowledge, philosophy of science). The other categories embody our knowledge of the explored phenomena. All the pillars, except pillar 8, share the theory-embodiment structure. Pillar 8, thought and art, is divided into three sections: thought, literature, and the arts (nonliterary arts) and each one has its own theory-embodiment structure.

At the field level, the "theory" section is implemented in the theory of the field (e.g., philosophy of medicine is part of the "theory" section of medicine). The other sections embody our knowledge of the relevant phenomena. In the example of medicine, these include internal medicine, pediatrics, surgery, and the like.

10 Knowledge Domains

We focus on the 10 knowledge domains and analyze how they are covered by the three systems.

Foundations

The meta-knowledge of human knowledge is represented in pillar 1, foundations, which is divided into four main categories: theory (1.1), context (1.2), methodology (1.3), and mediation (1.4). The three classification systems cover the metaknowledge domain. Table 1 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 2

TABLE 1. Foundations of knowledge (Pillar 1) at the main classes.

Foundations				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
1.1. Theory	**P**hilosophy of knowledge **P**hilosophy of science	B	000; 100	0; 1
1.2. Context	**H**istory of science **S**ociology of knowledge	A; Q	500	
1.3. Methodology	**M**ethodology of science			
1.4. Mediation	**I**nformation science **M**useology **S**cientometrics	A; C; Z	000	0

TABLE 2. Foundations of knowledge (Pillar 1) at the main subclasses.

Foundations				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
1.1. Theory	**P**hilosophy of knowledge **P**hilosophy of science	BD	000; 120	00; 16
1.2. Context	**H**istory of science **S**ociology of knowledge	AZ; Q	509	
1.3. Methodology	**M**ethodology of science			
1.4. Mediation	**I**nformation science **M**useology **S**cientometrics	AM; CD; Z	020; 060	02; 06

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presents the specific subclasses at the second level of each classification.

Theory (1.1) is focused on the philosophical perspectives of knowledge and includes philosophy of knowledge (epistemology), and philosophy of science. Theory is covered by LCC (BD), DDC (000; 120) and UDC (00; 16). Context (1.2) is focused on the historical and sociological perspectives of knowledge and includes history of science and sociology of knowledge. Context is covered by LCC (AZ; Q), and partially by DDC (509 history of science). Note, however, that sociology of knowledge is covered by DDC at a lower level of the hierarchical structure by the 306.42 subclass. Context is not covered by UDC. Methodology (1.3) is focused on the methodological perspectives of knowledge and includes one field, methodology of science, which covers research methodologies in general. It refers to, for example, a general study on qualitative research. Methodology is not covered by LCC, DDC, and UDC. Note, however, that in the DDC, for example, all fields have methodology sections that are represented by notation 01 from Table 1. Mediation (1.4) is focused on the mediating perspectives of knowledge and includes information science, museology, and scientometrics. Mediation is covered by LCC (AM; CD; Z), DDC (020; 060) and UDC (02; 06). Apparently, none of the three systems comprehensively covers the metaknowledge perspectives of human knowledge.

Supernatural

The supernatural phenomena are represented in pillar 2, supernatural, which is divided into three main categories: theory (2.1), mysticism (2.2), and religions (2.3). The three classification systems cover the supernatural phenomena knowledge domain. Table 3 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 4 presents the specific subclasses at the second level of each classification.

Theory (2.1) focuses on the philosophical and theoretical perspectives of the supernatural phenomena, including mysticism and religion, and includes religious studies, philosophy of religion, sociology of religion, and the like. Theory is covered by LCC (BL), DDC (210), and UDC (2).

Mysticism (2.2) includes a generic field, mysticism, which explores all kinds of mystic phenomena that are not exclusively related to specific religions. Religion-based mysticism, such as Kabbalah, which is part of the Jewish mysticism, is studied within the context of the relevant religion. The category is covered only by LCC (Parapsychology (BF1001-1389), Occult sciences (BF1404-2055)), and DDC (Parapsychology and occultism (130)). In both systems, the mystical phenomena are represented in third-level classes, as subclasses of psychology and philosophy (mutatis mutandis), rather than religion. This is strange because both systems assign parapsychology and occultism mainly to religious phenomena. Evidently, the coverage of mysticism by LCC and DDC is not systematic.

Religions (2.3) is focused on the world religions, which are classified into five classes: ancient, monotheism, asian, modern, and ethnic. The three classification systems cover the various religions. However, the scope and structure of the coverage are different. Ancient religions (2.3.1) are represented by LCC in various subclasses of religions, mythology, rationalism (BL; e.g., the myth, comparative mythology

TABLE 3. Supernatural: Mysticism and religion (Pillar 2) at the main classes.

Supernatural				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
2.1. Theory	**R**eligious studies	B	200	2
2.2. Mysticism	**M**ysticism	B	100	
2.3. Religions				
2.3.1. Ancient	**E**gyptian mythology **G**reek mythology	B	200	2
2.3.2. Monotheism	**J**udaism **C**hristianity **I**slam	B	200	2
2.3.3. Asian	**B**uddhism **J**ainism **S**ikhism **C**onfucianism **T**aoism **S**hinto **B**ahaism **Z**oroastrianism	B	200	2
2.3.4. Modern	**S**cientology		200	2
2.3.5. Ethnic	**S**hamanism **V**oodoo		200	2

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TABLE 4. Supernatural: Mysticism and religion (Pillar 2) at the main subclasses.

Supernatural				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
2.1. Theory	**R**eligious studies	BL	210	2
2.2. Mysticism	**M**ysticism	BF	130	
2.3. Religions				
2.3.1. Ancient	**E**gyptian mythology **G**reek mythology	BL	290	21; 25
2.3.2. Monotheism	**J**udaism **C**hristianity **I**slam	BM; BP; BR; BS; BT; BV; BX	220; 230; 240; 250; 260; 270; 280; 290	26; 27; 28
2.3.3. Asian	**B**uddhism **J**ainism **S**ikhism **C**onfucianism **T**aoism **S**hinto **B**ahaism **Z**oroastrianism	BL; BP; BQ	290	22; 23; 24
2.3.4. Modern	**S**cientology		290	29
2.3.5. Ethnic	**S**hamanism **V**oodoo		290	25

[BL300-325]). DDC represents the category in several subclasses of other religions (290; e.g., Greek and Roman religion [292]). UDC represents ancient religions in two subclasses: prehistoric and primitive religions (21) and religions of antiquity and minor cults and religions (25).

Monotheist religions, namely, Judaism, Christianity, and Islam (2.3.2), are covered by LCC, DDC, and UDC. LCC covers Judaism, Christianity, and Islam in seven subclasses: Judaism (BM); Islam, Bahism, and theosophy (BP); Christianity (BR); The Bible (BS); doctrinal theology (BT); practical theology (BV); and Christian denominations (BX). The seven classes are not mutually exclusive. The three last classes, doctrinal theology (BT), practical theology (BV), and Christian denominations (BX), should be subclasses of Christianity (BR), rather than at the same level of the hierarchical structure. The classes differ by the types of objects they represent. Three classes–Judaism (BM), Christianity (BR), and Islam, Bahism, theosophy (BP)–represent religions. Note that BM and BR represent specific religions while BP represents several religions. One class, BS, represents scriptures. Two classes, BT and BV, represent religious ideologies (i.e., thoughts), and one class, BX, represents religious groups (i.e., people). Religions, scriptures, thoughts, and people belong to different types of objects. Evidently, the representation of the monotheist religions by LCC is not systematic and Christianity biased.

The way DDC covers the monotheist religions is even more problematic. DDC dedicates eight subclasses to the three religions: Bible (220); Christianity and Christian theology (230); Christian practice and observance (240); Christian pastoral practice and religious orders (250); Christian organization, social work, and worship (260); history of Christianity (270); Christian denominations (280); and other religions (290). Six classes are exclusively dedicated to Christianity, and one is dedicated to the Bible, which is common to both Judaism and Christianity (i.e., Bible [220]). Only one class, other religions (290), represents Judaism and Islam in addition to all the other religions. Evidently, this knowledge representation is incomplete, unsystematic, and Christianity biased.

UDC representation of the monotheism category is balanced. UDC dedicates three unique classes—a class for each religion: Judaism (26), Christianity (27), and Islam (28). However, the coverage of the three knowledge domains is incomplete and, therefore, not systematic.

Asian religions (2.3.3) are covered by the three systems. LCC represents the Asian religions in three classes: religions, mythology, and rationalism (BL); Islam, Bahism, theosophy (BP); and Buddhism (BQ). The knowledge covered in the three classes is incomplete and not systematic. For example, Hinduism and Jainism are treated within the broader subclass history and principles of religions (BL660-2680). This class can be used as an umbrella name for all religions. However, several religions including Hinduism and Jainism are exclusively represented in this class, while other religions (e.g., Buddhism) are represented in separate classes.

DDC relates to all the religions, except Christianity, in the vague category named "other religions" (290). Zooming into the other religions category shows that knowledge representation of Asian religions is incomplete at the top two levels of the hierarchical structure.

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UDC relates to the Asian religions in three classes: religions of the Far East (22), religions of the Indian subcontinent (23), and Buddhism (24). Apparently, the scope of the coverage is comprehensive, because all the Asian religions are included under the 22 class, which is an umbrella class for all the Asian religions. However, for this very reason, the structure is not systematic. Classes 23 and 24 should be subclasses of class 22, rather than belong to the same level of the hierarchical structure.

Modern religions and ethnic religions are not covered by LCC in the first two levels of the hierarchical classification. DDC relates to modern and ethnic religions in one subclass (290), under the strange title "religions not provided for elsewhere" (299). Apparently, this is incomplete and unsystematic coverage. UDC relates to modern religions in the modern spiritual movements (29) class. Ethnic religions are covered in UDC in the minor cults and religions (25), but the coverage is incomplete.

To summarize, the three systems cover the supernatural knowledge domain. LCC and DDC coverage is incomplete, unsystematic, and Christianity biased. UDC coverage is more balanced, but it is still too incomplete and not systematic. The unsystematic character of the UDC structure is also apparent at the subclasses level. The religion/theology (2) class comprises nine subclasses: five relate to groups of religions (21, 22, 23, 25, and 29), while four relate to specific religions (24, 26, 27, and 28).

Matter and Energy

The physical universe is represented in pillars 3 and 4. Pillar 3 focuses on the basics of the physical universe and is divided into three categories: theory (3.1), principles (3.2), and substances (3.3). The three classification systems cover the basics of the physical universe. Table 5 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 6 presents the specific subclasses at the second level of each classification.

Theory (3.1) represents philosophy of physics and philosophy of space and time. The category is covered in LCC by the science general (Q1-295) subclass. In DDC, it is covered by the philosophy and theory (501) subclass. DDC covers the theory category in the physics (53) subclass, as part of physics, rather than an independent class that relates to the entire physical phenomena. Despite this critique, we conclude that the three systems comprehensively and systematically cover the theory category.

Principles (3.2) includes physics. LCC relates to physics in the physics (QC1-999) class. Note that the last two subclasses of physics (QC1-999), geomagnetism (QC811-849) and meteorology and climatology (QC851-999), belong to earth sciences rather than to physics. However, these inaccuracies can be attributed to a lack of better classes in the LCC structure rather than to a misconception of physics. DDC represents physics in the physics (530) subclasses. UDC represents physics in the physics (53) subclasses. Generally, the knowledge coverage of physics by LCC, DDC, and UDC seems to be comprehensive and systematic.

Substances (3.3) represents chemistry. LCC represents chemistry in the chemistry (QD1-999) class. The last subclass of chemistry, crystallography (QD901-999), is not part of chemistry. This presents an interesting situation. On one hand, the coverage of chemistry by LCC is not systematic (because crystallography is not a subfield of chemistry), but

TABLE 5. Matter and energy (Pillar 3) at the main classes.

Matter & Energy				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
3.1. Theory	**P**hilosophy of physics **P**hilosophy of space and time	Q	500	5
3.2. Principles	**P**hysics	Q	500	5
3.3. Substances	**C**hemistry	Q	500	5

TABLE 6. Matter and energy (Pillar 3) at the main subclasses.

Matter and energy				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
3.1. Theory	**P**hilosophy of physics **P**hilosophy of space and time	Q	500	53
3.2. Principles	**P**hysics	QC	530	53
3.3. Substances	**C**hemistry	QD	540	54

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on the other hand, the field of crystallography should be placed here in the substances category. Therefore, if we ignore this critique, then the coverage of the substances category by LCC is comprehensive and systematic.

This seems to be the case with DDC and UDC as well. Both classification schemes list crystallography and mineralogy among the chemistry subclasses. In DDC, the chemistry and allied sciences (540-549) classes include crystallography (548) and mineralogy (549). In UDC, the chemistry, crystallography, and mineralogy (54: 542-549) class includes two subclasses, crystallography (548) and mineralogy (549), that are not part of chemistry. However, it seems that the editors of both systems are aware of the distinction among chemistry, crystallography, and mineralogy. The inclusion of the three fields in the same class seems to be related to the limitations of the decimal principle rather than to misconceptions regarding the fields. Consequently, we ignore this critique and characterize the coverage of the substances category by DDC and UDC as being comprehensive and systematic.

To summarize, the basics of the physical universe are covered by LCC, DDC, and UDC. The coverage is comprehensive and systematic. Still, the editors of the three systems need to separate among chemistry, crystallography, and mineralogy while revising their systems.

Space and Earth

The outer space and the earth are represented in pillar 4, which is divided into three main categories: theory (4.1), space (4.2), and earth (4.3). The three classification systems cover the space and earth phenomena. Table 7 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 8 presents the specific subclasses at the second level of each classification.

Theory (4.1) represents cosmological theory, or scientific cosmology, which is the study of the universe as a unified whole and its origin. It is a field of knowledge aiming at providing a scientific based explanation of the nature of the physical universe and its origin. LCC and DDC cover the 4.1 category. LCC uses the astronomy (QB349-421 and QB980-991) subclass. UDC uses the astronomy (521 and 524.8) subclass.

Space (4.2) includes astronomy. LCC (QB), DDC (520), and UDC (52) cover the category. Note that the three astronomy subclasses (QB, 520, and 52) need to be revised because they include subjects that belong to earth sciences rather than astronomy. LCC includes geodesy, which is a subfield of geology. DDC includes mathematical geography and "earth (astronomical geography)." UDC includes geodesy, cartography, and aerial photography.

TABLE 7. Space and Earth (Pillar 4) at the main classes.

Space and earth				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
4.1. Theory	**C**osmological theory	Q		5
4.2. Space	**A**stronomy	Q	500	5
4.3. Earth				
4.3.1. Surface and substance	**P**hysical geography **G**eology **S**oil sciences	G; Q	500	5
4.3.2. Interrelations	**A**griculture **E**nvironmental sciences **N**atural hazards	S	600	5; 6

TABLE 8. Space and Earth (Pillar 4) at the main subclasses.

Space and earth				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
4.1. Theory	**C**osmological theory	QB		**52**
4.2. Space	**A**stronomy	QB	520	**52**
4.3. Earth				
4.3.1. Surface and substance	**P**hysical geography **G**eology **S**oil sciences	G; GA; GB; GC; QE	550	52; 54; 55
4.3.2. Interrelations	**A**griculture **E**nvironmental sciences **N**atural hazards	GE; S; SB; SD; SF; SH	630	50; 63

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Earth (4.3) is divided into two subcategories, surface and substance (4.3.1), and interrelations (4.3.2). Surface and substance is focused on exploring the surface and substance of the earth. The category includes physical geography, geology, and soil sciences. The category is covered by the three systems. LCC represents the category in five subclasses: geography (general; G); mathematical geography and cartography (GA); physical geography (GB); oceanography (GC); and geology (QE). The structure does not reflect the relationship among these fields. Mathematical geography and oceanography are subfields of physical geography.

DDC represents the category in the earth sciences and geology (550) subclass. The title and the structure of the subclass are confusing and need to be revised because geology is part of earth sciences.

UDC represents the 4.3.1 category in three subclasses: astronomy, astrophysics, space research, geodesy (52); chemistry, crystallography, mineralogy (54); and earth sciences, geology, meteorology (55). The structure is unsystematic and does not reflect the relationship among these fields. "Earth sciences" is an umbrella name for all the sciences that explore the earth. Earth sciences include geography (which includes meteorology) and geology (which includes crystallography, geodesy, and mineralogy). It seems that in UDC (as well as in DDC), "earth sciences" is equivalent to "geography." However, replacing "earth sciences" with "geography" will not resolve the confusion.

Interrelations (4.3.2) is focused on the relations between the earth and humans and comprises three fields: agriculture, environmental sciences, and natural hazards. These fields are interdisciplinary and relate to several pillars. Agriculture, for example, explores the cultivation of the earth and its main subfields are as follows: horticulture (the study of plant cultivation); forestry (the study of managing forests and tree plantations); animal husbandry (the study of breeding and raising livestock); aquaculture (the study of farming of freshwater organisms); and fishery (the study of raising and harvesting fishes). Modern agriculture is an interdisciplinary field, which embodies the use of natural resources (soil and water) for improving biological-based products (for example, meat, fruits, and vegetables) by human involvement and technologies (e.g., genetic engineering, pesticides, and agricultural machinery). Therefore, the following three pillars can represent agriculture: space and earth (pillar 4), nonhuman organisms (pillar 5), and technology (pillar 9). To avoid confusion, agriculture, environmental sciences, and natural hazards are listed only here.

Natural hazards explores the efficient ways to control the devastating powers of nature and facing natural catastrophes. It is an interdisciplinary field. The main hazards are as follows: geological hazards (avalanches, earthquakes, landslides and mudflows, sinkholes, and volcanic eruptions); hydrological hazards (floods and tsunamis); climatic and atmospheric hazards (blizzards/winter storms); droughts and hailstorms (frozen rain); heat waves and cyclonic storms (hurricanes); ice storms; tornados; and wildfires.

LCC covers the category in environmental sciences (GE), agriculture (general) (S), plant culture (SB), forestry (SD), animal culture (SF), and aquaculture, fisheries, angling (SH). DDC covers the interrelations category in the agriculture (630). UDC covers the interrelations category in the environmental sciences: conservation of natural resources, threats to the environment, and protection (502/504); and agriculture and related sciences and techniques, forestry, farming, and wildlife exploitation (63). It seems that LCC, DDC, and UDC adequately cover agriculture and environmental sciences, but the coverage of natural hazards is incomplete.

To summarize, the coverage of the earth and space knowledge domain by the three systems is incomplete and unsystematic.

The Living World

The living world is represented in pillars 5 and 6. The nonhuman living world is represented in pillar 5, which is divided into three categories: theory (5.1), basic sciences (5.2), and health and well-being (5.3). The three classification systems cover the nonhuman living world. Table 9 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 10 presents the specific subclasses at the second level of each classification.

Theory (5.1) is focused on the philosophical and ethical perspectives, which comprises philosophy of biology and bioethics. The category is covered in LCC by the biology (general; QH) subclass. In UDC, it is covered by the general and theoretical biology (573) subclass. DDC covers the category in the 570.1 subclass.

Basic sciences (5.2) is focused on biology and its various subfields, except human biology. LCC represents biology in the natural history-biology (QH), botany (QK), zoology (QL), physiology (QP), and microbiology (QR) subclasses. The coverage of biology in these LCC's classes is incomplete and unsystematic. Main subfields of biology are missing (e.g., developmental biology). Evidently, the structure of the biological sciences is not systematic. Botany, zoology, physiology, and microbiology are subclass of biology, Therefore, subclasses QK, QL, QP, and QR should be subclasses of QH rather than belonging to the same level of the hierarchical classification as subclasses of Q. Furthermore, the physiology (QP) class includes two unrelated subclasses, animal biochemistry (QP501-801) and experimental pharmacology (QP901-981). Clearly, biochemistry and pharmacology are not subfields of physiology. Physiology and biochemistry are subfields of biology, while pharmacology is an independent field of knowledge. To summarize, the coverage of the basic sciences category by LCC is incomplete and unsystematic.

Both DDC's and UDC's representations of the biological sciences are similar. Both systems have four main subclasses. DDC represents the following subclasses: biological sciences in fossils and prehistoric life (560); life sciences and biology (570); plants (botany; 580); and animals (zoology; 590). UDC represents the following subclasses: biological sciences in

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TABLE 9. Non-human organisms (Pillar 5) at the main classes.

Non-Human Organism				
10 Pillars		LCC	DDC	UDC
Categories	Fields	classes	classes	classes
5.1. Theory	**P**hilosophy of Biology **B**ioethics	Q	500	5
5.2. Basic Sciences	**B**iology	Q; S	500	5
5.3. Health & Wellbeing	**V**eterinary Medicine	S		

TABLE 10. Non-human organisms (Pillar 5) at the main subclasses.

Non-Human Organism				
10 Pillars		LCC	DDC	UDC
Categories	Fields	classes	classes	classes
5.1. Theory	**P**hilosophy of Biology **B**ioethics	QH	570	57
5.2. Basic Sciences	**B**iology	QH; QK; QL; QP; QR;	560; 570; 580; 590	56; 57; 58; 59
5.3. Health & Wellbeing	**V**eterinary Medicine	SF		

palaeontology (56); biological sciences in general (57: 573–579); botany (58); and zoology (59). Both representations are neither comprehensive nor systematic, for the same reasons. First, the four-class structure–paleontology, biology, plants (botany), and animals (zoology)–is not systematic. The four fields do not belong to the same level of the hierarchy. These are not four distinct fields of the same level. Paleontology, botany, and zoology are subfields of biology. The structures of DDC and UDC are misleading. Lay people can easily misunderstand the logical relations among the four concepts. Second, both classifications do not represent main biological sciences. For example, UDC and DDC do not refer to the anatomy of nonhuman organisms. Evidently, DCC and UDC fail to comprehensively and systematically cover contemporary scientific knowledge in the biological sciences.

Health and well-being (5.3) represents veterinary medicine. LCC represents veterinary medicine in the veterinary medicine (SF600-1100) class, which is a subclass of agriculture (SF). Evidently, veterinary medicine is not a subfield of agriculture; therefore, LCC's representation of the health and well-being category is not systematic. Surprisingly, DDC and UDC do not represent the field of veterinary medicine in the first three levels of their hierarchical structures.

To summarize, pillar 5, which represents our knowledge on the nonhuman living world, is covered by LCC, DDC, and UDC. Regrettably, the three classification systems fail to adequately cover the knowledge domain. The three representations of the knowledge domain are incomplete and unsystematic.

Body and Mind

The human body (chemo-physical) and mind is represented in pillar 6, body and mind, which is divided into three categories: theory (6.1), basic sciences (6.2), and health and well-being (6.3). The three classification systems cover the phenomena. Table 11 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 12 presents the specific subclasses at the second level of each classification.

Theory (6.1) is focused on the philosophical and ethical perspectives of the human body and mind phenomena, which comprises philosophy of life, philosophy of mind, and bioethics. The category is covered in LCC by the ontology (BD300-450) subclass. Note that subclass R723-726 (medical philosophy and medical ethics) that is focused on the philosophical perspectives of medicine covers category 6.3.1 rather that category 6.1. UDC uses philosophy of mind (13) subclass. DDC does not cover the 6.1 category.

Basic sciences (6.2) is focused on the biological and psychological aspects of the human body and mind diversified phenomena. The category represents human biology, psychology, neuroscience, and cognitive science. LCC covers the category in the psychology (BF), biology (general; QH301-705.5), human anatomy (QM), and, partially, in physiology (QP1-495) classes. DDC covers the category in the psychology (150), life sciences and biology (570), human anatomy, cytology, and histology (611), and human physiology (612) subclasses, which are subclasses of medicine and health (610). UDC covers the basic sciences category in psychology (159.9), biological sciences (57), and medical sciences (61) subclasses. Note that psychology has a strange number

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TABLE 11. Body and mind (Pillar 6) at the main classes.

Body and mind				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
6.1. Theory	**P**hilosophy of life **P**hilosophy of mind **B**ioethics	R		1
6.2. Basic sciences	**H**uman biology **P**sychology **N**euroscience **C**ognitive science	B; Q	100; 500; 600	1; 5; 6
6.3. Health and well-being				
6.3.1. Medical sciences	**M**edicine **D**entistry	R	600	6
6.3.2. Paramedical studies	**A**udiology **C**linical psychology **M**idwifery **N**ursing **N**utrition **O**ccupational therapy **O**ptometry **P**hysical therapy **P**ublic health **S**peech therapy	R	600	6
6.3.3. Complementary medicine	**A**yurvedic medicine **C**hinese medicine **H**omeopathy	R		

TABLE 12. Non-human organisms (Pillar 6) at the main subclasses.

Body and mind				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
6.1. Theory	**P**hilosophy of life **P**hilosophy of mind **B**ioethics	BD		13
6.2. Basic sciences	**H**uman biology **P**sychology **N**euroscience **C**ognitive science	BF; QH; QM; QP	150; 570; 610	159.9; 57; 61
6.3. Health and well-being				
6.3.1. Medical sciences	**M**edicine **D**entistry	R; RA; RB; RC; RD; RE; RF; RG; RJ; RK; RL, RM	610	61
6.3.2. Paramedical studies	**A**udiology **C**linical psychology **M**idwifery **N**ursing **N**utrition **O**ccupational therapy **O**ptometry **P**hysical therapy **P**ublic health **S**peech therapy	RE; RM; RS; RT	610	61
6.3.3. Complementary medicine	**A**yurvedic medicine **C**hinese medicine **H**omeopathy	RV; RX; RZ		

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(159.9), rather than 15. To summarize, the coverage of the 6.2 category by the three systems is partial.

Health and well-being (6.3) is focused on human health and medical sciences. The category comprises three main subcategories: medical sciences (6.3.1), paramedical studies (6.3.2), and complementary medicine (6.3.3). Medical sciences (6.3.1) includes medicine and dentistry. The category is covered by LCC, DDC, and UDC. LCC uses class R and its subclasses are as follows: R, RA, RB, RC, RD, RE, RF, RG, RJ, RK, RL, and RM. In comparing the topics covered by LCC with the topics covered by the National Library of Medicine (NLM; http://www.nlm.nih.gov/pubs/factsheets/nlmclassif.html) classification system, it becomes clear that many important fields are missing. DDC covers the category in medicine and health (610) subclass. UDC covers the category in medical sciences (61) category. Paramedical studies (6.3.2) includes various fields, such as audiology, clinical psychology, midwifery, nursing, nutrition, occupational therapy, optometry, physical therapy, public health, speech therapy. LCC covers the category in RE, RM, RS, and RT subclasses. DDC covers the category in class 610. UDC covers the category in class 61. Complementary medicine (6.3.3) is covered only by LCC in RV, RX, and RZ subclasses.

To summarize, LCC, DDC, and UDC cover the human body and mind diversified phenomena, but the coverage is incomplete and unsystematic.

Society

The human society is represented in pillar 7, society, which is divided into four categories: theory (7.1), society at-large (7.2), domains (7.3), and social groups (7.4). The three classification systems cover the various perspectives of human social life. Table 13 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 14 presents the specific subclasses at the second level of each classification.

Theory (7.1) is focused on the philosophical basis of social life and the social sciences. The category contains two fields: philosophy of social sciences and social philosophies. The category is covered in LCC by the social sciences (general; H) and HX subclasses. DDC covers the category in the social sciences (301.1) subclass. UDC covers the category in the theories and methods in social sciences (30) subcategory.

Society at-large (7.2) represents social sciences that encompasses diversified social aspects. These integrated fields are grouped into two categories: general and area-based. The general category (7.2.1) represents four fields: sociology, anthropology, human geography, and demography. The category is covered by LCC, DDC, and UDC. LCC covers the category in 11 subclasses: geography (general; G), GF, GN, GR, GT, HB, HM, HN, HQ, HS, and HT. DDC covers the category in 300 (300-307), 390, 910 subclasses. UDC covers the category in 31, 39, and 91.

The area-based category (7.2.2) comprises hundreds of fields that fit the umbrella name "area studies." These are multidisciplinary fields of research and scholarship relating to particular geographical areas. Area studies is multidisciplinary, rather than interdisciplinary. It combines natural sciences (e.g., geography, geology, biology), social sciences (e.g., sociology, anthropology, political science, history), and humanities (e.g., literature, art, religion) in a unified academic framework. The area -based category (7.2.2) is not covered by LCC, DDC, and UDC.

The domains category (7.3) represents social sciences that focuses on specific areas of social life. The category comprises three main subcategories: community (7.3.1), needs and activities (7.3.2), and management (7.3.3). Community focuses on the basics of social life. Needs and activities focuses on human needs (e.g., education, health, security), and human activities (e.g., culture, economics, sport). Management focuses on the management and the administration of social life.

The community category (7.3.1) explores the basics of social life, which represents four main subcategories: communication (7.3.1.1), contract (7.3.1.2), codes (7.3.1.3), and conduct (7.3.1.4). Communication focuses on the basics of social interaction. Contract focuses on the "social contract" that underlies the binding power of social structures that control and regulate social life. Codes focuses on the guiding principles and rules (codes) of human conduct and social interaction. Conduct focuses on human behaviour in the social context.

Communication (7.3.1.1) represents four fields: semiotics, linguistics, languages (which is subdivided by world languages), and communication studies. LCC covers the category in the following 13 subclasses: P, PA, PB, PC, PD, PE, PF, PG, PH, PJ, PK, PL, and PM. DDC covers the category in the following 10 subclasses: 400, 410, 420, 430, 440, 450, 460, 470, 480, and 490. UDC covers the category in 80, 81, and 82 subclasses. The three systems focus mainly on linguistics and languages, but the coverage of thousands of natural languages is partial and unsystematic; DDC, for example, assigns eight subclasses for languages (class. 420-490). The first seven are assigned to specific languages—English, German, French, Italian, Romanian, Spanish, Portuguese, Latin, Italic, and Greek—, while the eighth subclass is assigned to all the other languages. Furthermore, the coverage of communication studies is inadequate. The three systems refer to the technological and the economic aspects of the communication industry (see class HE [LCC], 380 [DDC], and 654/659), but they do not refer to the social aspects of communication as a social phenomenon, which underlies any social and interpersonal interaction. To summarize, the coverage of the 7.3.1.1 category by the three systems is extensive, but it is not comprehensive and not systematic.

Contract (7.3.1.2) explores the theory and practice of political systems and the use and abuse of political power. The name of the category comes from the notion of social contract as the rational basis of national states. The category represents political science. LCC covers the category in the following 13 subclasses: CD, J, JA, JC, JF, JJ, JK, JL, JN,

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TABLE 13. Society (Pillar 7) at the main classes.

Society				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
7.1. Theory	**P**hil. of soc. sciences **S**ocial philosophy	H	300	3
7.2. Society at-large				
7.2.1. General	**S**ociology **A**nthropology **H**uman geography **D**emography	G; H	300; 900	3; 9
7.2.2. Area-based	**A**rea studies (classified by area)			
7.3. Domains				
7.3.1. Community				
7.3.1.1. Communication	**S**emiotics **L**inguistics **L**anguages **C**ommunication studies	P	400	8
7.3.1.2. Contract	**P**olitical science	C; J	100; 300	3
7.3.1.3. Codes	**E**thics **L**aw	B; K	100; 300	1 ; 3
7.3.1.4. Conduct	**S**ocial psychology **C**riminology	H		3
7.3.2. Needs and activities	**C**ultural studies **E**conomics **E**ducation **P**ublic health **R**ecreation **S**ocial work **S**port **T**ourism **U**rban planning	A; C; G; H; L; S; T; U; V	300; 600; 700; 900	3; 6; 7
7.3.3. Management	**M**anagement studies	J	300; 600	0; 3; 6
7.4. Social groups				
7.4.1. Gender	**M**en's studies **W**omen's studies	H		3
7.4.2. Age	**Y**outh studies **G**erontology			
7.4.3. Ethnicity	**E**thnic studies (ethnic subdivision)			
7.4.4. Interest	**F**amily studies **G**ay and lesbian studies	H		

JQ, JS, JV, and JZ. DDC covers the category in 172 (political ethics) and 320 subclasses. UDC covers the category in 32 and 35 subclasses. LCC, DDC, and UDC adequately cover the category.

Codes (7.3.1.3) represents ethics and law. LCC, DDC, and UDC cover the category. LCC uses the following 16 subclasses: BJ (Ethics); K (Law, general); KB (Religious law) and its subclasses; KBM (Jewish law); KBP (Islamic law); KBR (Canon law); KBU (Roman Catholic law); KD-KDK (UK and Ireland); KDZ (America. North America); KE (Canada); KF (US); KG (Latin America); KH (South America); KJ-KKZ (Europe); KL-KWX (Asia and Eurasia, Africa, Pacific Area, and Antarctica); KZ (Law of nations). DDC uses two subclasses, 170 (Ethics) and 340 (Law). UDC uses two subclasses, 17 (Ethics) and 34 (Law).

We zoom into the law. Apparently, LCC coverage of law is extensive, but incomplete and unsystematic. LCC assigns 15 subclasses for law. Two subclasses focus on the core knowledge of the field (K, and KZ). Five subclasses focus on religious law, mainly on Christian, Jewish, and Islamic law (KB, KBM, KBP, KBR, and KBU). Eight subclasses (KD-KDK, KDZ, KE, KF, KG, KH, KJ-KKZ, and KL-KWX) focus on national legal systems. Apparently, DDC coverage of law is extensive, but incomplete and unsystematic. DDC assigns 10 subsubclasses for law. Nine subclasses focus on the core knowledge of the field (340-348); one subclass is

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TABLE 14. Society (Pillar 7) at the main subclasses.

Society				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
7.1. Theory	**P**hil. of soc. sciences **S**ocial philosophy	H; HX	301	30
7.2. Society at-large				
7.2.1. General	**S**ociology **A**nthropology **H**uman geography **D**emography	G; GF; GN; GR; GT; HB; HM; HN; HQ; HS; HT;	300–307; 390; 910	31; 39; 91
7.2.2. Area-based	**A**rea studies (classified by area)			
7.3. Domains				
7.3.1. Community				
7.3.1.1. Communication	**S**emiotics **L**inguistics **L**anguages **C**ommunication studies	P; PA; PB; PC; PD; PE; PF; PG; PH; PJ; PK; PL; PM	400; 410; 420; 430; 440; 450; 460; 470; 480; 490	80; 81; 82
7.3.1.2. Contract	**P**olitical science	CD; J: JA; JC; JF; JJ; JK; JL; JN; JQ; JS; JV; JZ	170; 320	32; 35
7.3.1.3. Codes	**E**thics **L**aw	BJ; K; KB; KBM; KBP; KBR; KBU; KD-KDK; KDZ; KE; KF; KG; KH; KJ-KKZ; KL-KWX; KZ	170; 340	17; 34
7.3.1.4. Conduct	**S**ocial psychology **C**riminology	HV	360	31; 34
7.3.2. Needs and activities	**C**ultural studies **E**conomics **E**ducation **P**ublic health **R**ecreation **S**ocial work **S**port **T**ourism **U**rban planning	AS; CJ; GV; HB; HC; HD; HE; HF; HG; HJ; HV; L; LA; LB; LC; LD; LE; LF; LG; LJ; SH; SK; TS; TX; U; UA; UB; UC; UD; UE; UF; UH; V; VA; VB; VC; VD; VE; VF; VG; VK	330; 350; 360; 370; 380; 640; 790; 910	33; 36; 37; 64; 65; 71; 79
7.3.3. Management	**M**anagement studies	JF; JJ; JK; JL; JN; JQ; HD; HF; HG	350; 650	00; 35; 65
7.4. Social groups				
7.4.1. Gender	**M**en's studies **W**omen's studies	HQ		30
7.4.2. Age	**Y**outh studies **G**erontology			
7.4.3. Ethnicity	**E**thnic studies (ethnic subdivision)			
7.4.4. Interest	**F**amily studies **G**ay and lesbian studies	HQ		

focused on national and area-based legal systems (349). UDC assigns 10 subsubclasses for law. Nine subclasses focus on the core knowledge of the field (34-347, 349); one subclass is focused on religious law (348).

The field of law encompasses the following areas: legal theory (i.e., the theoretical foundations of the law, including history of law, philosophy of law, or jurisprudence); sociology of law and economy of law; legal systems (i.e., civil law, common law, and religious law); legal areas (i.e., public law including constitutional law, administrative law, and criminal law); private law (contract law, tort law, and property law) and international law; legal institutions (the judiciary

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system and the legislature system); legal issues (e.g. human rights, end of life issues, and copyright issues); national legal systems (subdivided by countries); and legal professions. Upon reviewing how each of the three systems covers law, it is evident that the coverage is extensive. To be specific, LCC's coverage of the core knowledge of law seems to be comprehensive, but it is definitely unstructured. The coverage of religious law is incomplete and unsystematic. It ignores Asian and modern religions. The coverage of national and area-based law seems comprehensive, but it is not systematic because the attention to North America is not proportional. Without delving into details, the coverage by DDC and UDC seems complete and systematic. To summarize, the coverage of the 7.3.1.3 category by the three systems is extensive. However, the cover by LCC is incomplete and unsystematic, while the cover by DDC and UDC is complete and systematic.

Conduct (7.3.1.4) involves human social behavior. It represents social psychology and criminology. LCC covers the category in the HV subclass. DDC covers the category in the 360 subclass. UDC covers the category in the 31 (316.6 [social psychology]) and the 34 (343.9 [criminology]) subclass. Without delving into details, the coverage by the three systems seems complete and systematic.

The needs and activities category (7.3.2) encompasses areas of human activity and represents cultural studies, economics, education, public health, recreation, social work, sport, tourism, urban planning, and the like. The three systems cover the category. LCC covers the category in 41 subclasses: AS, CJ, GV, HB, HC, HD, HE, HF, HG, HJ, HV, L (education [general]); LA, LB, LC, LD, LE, LF, LG, LJ, SH (angling); SK (hunting sports); TS (manufactures); TX (home economics); U (military science [general]); UA, UB, UC, UD, UE, UF, UH, V (naval science [general]); VA, VB, VC, VD, VE, VF, VG, and VK. DDC uses eight subclasses: 330 (economics); 350 (military science); 360 (social problems and social services); 370 (education); 380 (commerce, communications and transportation); 640 (home and family management); 790 (sports, games and entertainment); and 910 (travel). UDC uses seven subclasses: 33 (economics); 36 (social welfare); 37 (education); 64 (home economics); 65 (communication and transport industries. public relations); 71 (urban and rural planning); and 79 (recreation, entertainment, games, sport). Without delving into details, the coverage of the category by LCC, DDC, and UDC is complete and systematic.

The management category (7.3.3) is the study of the theory and practice of management and administration of social activities and organizations. The category includes a generic field–management studies–that relates to the public (e.g., governmental and NGOs) and private (e.g., business) sectors. LCC covers the public sector in six subclasses (JF, JJ, JK, JL, JN, and JQ) and the private sector in three subclasses (HD, HF, and HG). DDC and UDC cover the public and private sectors. DDC uses the 350 and 650 subclasses. UDC uses the 00 (005 subclass), 35, and 65 subclasses.

Social groups (7.4) represents group-based social sciences. The category comprises four subcategories, based on four bases: gender (7.4.1), age (7.4.2), ethnicity (7.4.3), and interest (7.4.4). The three classification systems partially cover the 7.4 category (see Tables 13 and 14).

To summarize, LCC, DDC, and UDC cover the human society diversified phenomena, but the coverage is incomplete and unsystematic.

Thought and Art

The products of the human intellect and the arts are represented in pillar 8, thought and art, which is divided into three main categories: thought (8.1), literature (8.2), and the arts (8.3). The three classification systems cover the various fields. Table 15 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 16 presents the specific subclasses at the second level of each classification.

Thought (8.1) is focused on the human thought and comprises three subcategories: reason (8.1.1), representation (8.1.2), and relations (8.1.3). Reason (8.1.1) includes the field of philosophy. LCC covers philosophy by the B, BC, BD, BH, BJ, and BL subclasses. DDC covers philosophy by the 100, 110, 120, 140, 160, 170, 180, and 190 subclasses. UDC covers philosophy by the 1, 101, 11, 13, 14, 16, and 17 subclasses. Note that logic is traditionally part of philosophy, although it is an independent field (see category 8.1.3). Representation (8.1.2) is centred on the basics of languages and includes philosophy of language and philology. LCC covers the category by the P subclass. DDC covers the category by the 401 subclass, and UDC covers it by the 80 and 81 subclasses. The coverage is adequate. Relations (8.1.3) includes three relation-based fields: logic, mathematics, and statistics. LCC covers the category by the BC (logic), HA, and QA subclass, DDC covers it by the 160, 310, and 510 subclass, and UDC covers it by the 16, 31 and 51 subclasses. To summarize, LCC, DDC, and UDC adequately cover the thought category.

Literature (8.2) includes one generic field, literature, and is the study of written works of art and covers all forms, genres, languages, eras, and places. Generally, literature is divided into two generic parts: literary theory (8.2.1) and literary forms (8.2.2). Literary theory (8.2.1) is covered by LCC (PN), DDC (800), and UDC (82) subclasses. Literary forms (8.2.2) is covered by LCC by the PA, PG, PJ, PK, PL, PN, PQ, PR, PS, PT, and PZ subclasses. DDC covers the category by the 810, 820, 830, 840, 850, 860, 870, 880, and 890 subclasses. UDC covers the category by the 82 subclass. To summarize, LCC, DDC, and UDC adequately cover the literature category.

The arts (8.3) represents fields that study the manifold aspects of nonliterary art. It encompasses all forms of nonliterary art worldwide throughout human history. Generally, the arts is divided into two generic parts, art theory (8.3.1) and art works (8.3.2). Theory (8.3.1) is covered by the LCC BH and NX subclasses. DDC is covered by the 700 subclass. UDC covers art theory by the 7 subclass. Art works or art forms (8.3.2) is covered by the LCC M, ML, MT, N, NA, NB, NC, ND, NE, NK, TR and TT subclasses. DDC covers the category by the 710, 720, 730, 740, 750, 760, 770, 780,

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TABLE 15. Thought and art (Pillar 8) at the main classes.

Thought and art				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
8.1. Thought				
8.1.1. Reason	**P**hilosophy	B	100	
8.1.2. Representation	**P**hilosophy of language **P**hilology	P	400	8
8.1.3. Relations	**L**ogic **M**athematics **S**tatistics	B; H; Q	100; 300; 500	1; 3; 5
8.2. Literature				
8.2.1. Theory	**L**iterary theory	P	800	8
8.2.2. Forms	**P**oetry **P**rose **D**rama **E**ssay	P	800	8
8.3. The arts				
8.3.1. Theory	**P**hilosophy of art **H**istory of art	B; N	700	7
8.3.2. Forms	**C**onceptual art **D**rawing **P**ainting **S**culpture **P**hotography **P**rintmaking **T**apestry **D**ance **M**usic **T**heater **O**pera **E**ntertainment **C**inematography **D**igital arts **A**pplied and design arts **A**rchitecture	M; N; T	700	7

and 790 subclasses. UDC covers the arts diversified works by the 7, 72, 73, 74, 75, 76, 77, 78, and 79 subclasses. To summarize, LCC, DDC, and UDC adequately cover the literature category.

To summarize, LCC, DDC, and UDC cover the thought and art diversified phenomena. An overall analysis shows that although some minor revisions are required, the coverage is adequate, complete and systematic.

Technology

The human technology is represented in pillar 9, technology, which deals with human-based technologies and technology-based professions. It is divided into three main categories: theory (9.1), professions (9.2), and technologies (9.3). Note that pillar 9 is focused on human technology while animal technology is studied by the biological sciences and represented in pillar 5 (nonhuman organisms). The three classification systems cover the various fields. Table 17 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 18 presents the specific subclasses at the second level of each classification.

Theory (9.1) is focused on the philosophical basis of the human technology. The category includes philosophy of technology, which explores the nature of technology and its social effects. The category is covered in LCC by the technology (general; T) subclass, but the coverage is incomplete. DDC covers the category in the philosophy and theory (601) subclass. UDC does not cover the philosophy of technology.

Professions (9.2) is focused on technology based professions, mainly on engineering. LCC covers engineering diversified subfields in 14 subclasses: TA, TC, TD, TE, TF, TG, TH, TJ, TK, TL, TN, TP, UG, and VM. DDC covers engineering in 620 and 660 subclasses. UDC covers engineering in 62, 63, 65, and 66 subclasses. The coverage, especially by UDC and LCC, is extensive. Still, it is not systematic because the user is required to delve down the classification rank to find the topic he or she needs.

Technology (9.3) is focused on the diversified human-based technologies. It includes the body of knowledge related

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TABLE 16. Thought and art (Pillar 8) at the main subclasses.

Thought and art				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
8.1. Thought				
8.1.1. Reason	**P**hilosophy	B; BC; BD; BH; BJ; BL	100; 110; 120; 140; 160; 170; 180; 190	1; 101; 11; 13; 14; 16; 17
8.1.2. Representation	**P**hilosophy of language **P**hilology	P	400	80; 81
8.1.3. Relations	**L**ogic **M**athematics **S**tatistics	BC; HA; QA	160; 310; 510	16; 31; 51
8.2. Literature				
8.2.1. Theory (literary theory)		PN	800	82
8.2.2. Forms	**P**oetry **P**rose **D**rama **E**ssay	PA; PG; PJ; PK; PL; PN; PQ; PR; PS; PT; PZ	810; 820; 830; 840; 850; 860; 870; 880; 890	82
8.3. The Arts				
8.3.1. Theory	**P**hilosophy of art **H**istory of art	BH; NX	700	7
8.3.2. Forms	**C**onceptual art **D**rawing **P**ainting **S**culpture **P**hotography **P**rintmaking **T**apestry **D**ance **M**usic **T**heater **O**pera **E**ntertainment **C**inematography **D**igital arts **A**pplied and design arts **A**rchitecture	M; ML; MT; N; NA; NB; NC; ND; NE; NK; TR; TT	710; 720; 730; 740; 750; 760; 770; 780; 790	7; 72; 73; 74; 75; 76; 77; 78; 79

to all the discovered, invented, developed, and used technologies in all civilizations throughout human history. The category encompasses manmade physical objects and processes, research methodologies, scientific applications, and production techniques. The category is divided into four main subcategories: sciences (9.3.1), needs and activities (9.3.2), materials (9.3.3), and processes (9.3.4).

Sciences (9.3.1) includes technologies that are grounded and centered on specific sciences. These technologies are the technological counterparts of the related sciences: nuclear technology; nanotechnology (technologies that sized between 1 to 100 nanometers—NM, one billionth of a meter); aerospace technology (i.e., aviation and space); biotechnology; and computer technology. Note that computer technology is based on mathematics. Needs and activities (9.3.2) explores technologies that are centered on specific human needs and activities. These technologies are the technological counterparts of the related fields: information technology, educational technology, food technology, military technology, sport technology, and transport-based technologies (e.g., automotive technology). Materials (9.3.3) explores technologies that are centered on specific natural or manmade materials that are used for achieving diversified purposes: ceramic technology, glass technology, metal technology (e.g., gold technology), mineral technology, and wood technology. Processes (9.3.4) explores technologies that are centered on specific processes that are used for achieving diversified purposes: cooling technology and heating technology, freezing technology and melting technology.

The coverage of the 9.3 category by LCC, DDC, and UDC is incomplete (see Tables 17 and 18). Upon reviewing the three systems, one can see that very often they do not differentiate between the profession (i.e., engineering) and the products (i.e., technologies), between the technologies and the related applied sciences, and between applied sciences and basic sciences. The coverage of engineering, technologies, basic sciences, and the related applied sciences is very often intermingled; therefore, the coverage is clearly unsystematic.

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TABLE 17. Technology (Pillar 9) at the main classes.

Technology				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
9.1. Theory	**P**hilosophy of technology	T	600	
9.2. Professions	**E**ngineering	T; U; V	600	6
9.3. Technologies				
9.3.1. Sciences	**A**rtificial intelligence **B**iotechnology **C**omputer science **M**aterials science **N**anotechnology **N**uclear technology	T	000	0; 6
9.3.2. Needs and activities	**E**ducational technology **F**ood technology **I**nformation technology	T	600	6
9.3.3. Materials	**C**eramic technology **G**lass technology **I**ron technology **M**ineral technology **W**ood technology			
9.3.4. Processes	**C**utting technology **F**reezing technology			

TABLE 18. Technology (Pillar 9) at the main subclasses.

Technology				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
9.1. Theory	**P**hilosophy of technology	T	601	
9.2. Professions	**E**ngineering	TA; TC; TD; TE; TF; TG; TH; TJ; TK; TL; TN; TP; UG; VM	620; 660	62; 63; 65; 66
9.3. Technologies				
9.3.1. Sciences	**A**rtificial intelligence **B**iotechnology **C**omputer science **M**aterials science **N**anotechnology **N**uclear technology	TP	000	00; 60; 64; 66
9.3.2. Needs and activities	**E**ducational technology **F**ood technology **I**nformation technology	TH; TL; TR	680; 690	62; 68; 69
9.3.3. Materials	**C**eramic technology **G**lass technology **I**ron technology **M**ineral technology **W**ood technology			
9.3.4. Processes	**C**utting technology **F**reezing technology			

To summarize, LCC, DDC, and UDC cover technology, but the coverage is incomplete and unsystematic.

History

The recorded human history is represented in pillar 10, history, which includes theory, universal memory, and relations. It is divided into three main categories: theory (10.1), universal memory (10.2), and relations (10.3). The three classifications cover the different perspectives of the human history. Table 19 maps the knowledge covered by the main classes of LCC, DDC, and UDC. Table 20 presents the specific subclasses at the second level of each classification.

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TABLE 19. History (Pillar 10) at the main classes.

History				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
10.1. Theory	**P**hilosophy of history	C	900	9
10.2. Universal memory	**H**istory **A**rcheology	A; C; D; E-F; U	900	9
10.3. Relations	**G**enealogy	C	900	9

TABLE 20. History (Pillar 10) at the main subclasses.

History				
10 Pillars		LCC	DDC	UDC
Categories	Fields	Classes	Classes	Classes
10.1. Theory	**P**hilosophy of history	C	901	93
10.2. Universal memory	**H**istory **A**rcheology	AZ; CB; CC; CD; CE ; CJ, CN; CR; CT; D; DA; DAW; DB; DC; DD; DE; DF; DG; DH; DJ; DJK; DK; DL; DP; DQ; DR; DS; DT; DU; DX; E-F; U	930; 940; 950; 960; 970; 980; 990	902; 93/94
10.3. Relations	**G**enealogy	CS	920	92

Theory (10.1) is focused on the philosophical basis of the human history. The category contains the field of philosophy of history. Note that the term "philosophy of history" refers to the philosophical reflections on the human past and the human existences in time. The philosophical basis of history as an academic discipline is dealt in the general memory (10.2) category, as subfield of history. LCC uses the C subclass. DDC uses the 901 subclass, and UDC uses the 93 (930.1) subclass.

Universal memory (10.2) includes two fields, history and archeology. LCC covers the category in the following subclasses: AZ, CB, CC, CD, CE, CJ, CN, CR, CT, D, DA, DAW, DB, DC, DD, DE, DF, DG, DH, DJ, DJK, DK, DL, DP, DQ, DR, DS, DT, DU, DX, E-F, and U. The coverage is comprehensive but not systematic, mainly because most subclasses are dedicated to Europe and America, while Asia, Africa, and Oceania get one subclass each. DDC covers history and archeology in the 930, 940, 950, 960, 970, 980, and 990 subclasses. UDC uses the 93/94, and 902 subclasses. Both DDC and UDC seem to cover history and archeology adequately.

Relations (10.3) is focused on relations among people and includes genealogy, the study of families and their history. LCC covers genealogy in the CS subclass, DDC uses the 920 subclass, and UDC uses the 92 subclass.

To summarize, LCC, DDC, and UDC cover the human history diversified phenomena. An overall analysis shows that although some minor revisions are required, in particular, classes C and D of LCC, the coverage is adequate, complete, and systematic.

Discussion and Conclusions

An Overall Analysis

An overall analysis of the knowledge covered by LCC, DDC, and UDC is presented in Table 21 and 22. Table 21 summarizes how the three systems cover the 55 subject categories of the 10-pillar model. The 55 categories are mutually exclusive and collectively cover the broad spectrum of human knowledge.

Of the 55 categories, 39 are represented by LCC, DDC, and UDC, as follows: 1, 4, 5, 6, 7, 8, 9, 12, 13, 14, 16, 17, 18, 19, 20, 23, 24, 25, 27, 28, 30, 31, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 48, 49, 50, 53, 54, and 55. Two categories (2 and 47) are represented by LCC and DDC. Three categories (15, 22, and 36) are represented by LCC and UDC. Two categories (10 and 11) are represented by DDC and UDC. Three categories (21, 26, and 39) are represented exclusively by LCC. Six categories are not represented at all by the three systems (3, 29, 37, 38, 51, and 52).

LCC covers the following 47 categories: 1, 2, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 53, 54, and 55. It does not cover the

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TABLE 21. The knowledge covered by category.

10 pillars		LCC	DDC	UDC
Pillars / Categories	Unique categories			
Pillar 1: Foundations				
1.1. Theory	1	+	+	+
1.2. Context	2	+	+	
1.3. Methodology	**3**			
1.4. Mediation	4	+	+	+
Pillar 2: Supernatural				
2.1. Theory	5	+	+	+
2.2. Mysticism	6	+	+	+
2.3. Religions				
2.3.1. Ancient	7	+	+	+
2.3.2. Monotheism	8	+	+	+
2.3.3. Asian	9	+	+	+
2.3.4. Modern	10		+	+
2.3.5. Ethnic	11		+	+
Pillar 3 Matter and energy				
3.1. Theory	12	+	+	+
3.2. Principles	13	+	+	+
3.3. Substances	14	+	+	+
Pillar 4 Space and earth				
4.1. Theory	15	+		+
4.2. Space	16	+	+	+
4.3. Earth				
4.3.1. Surface and substance	17	+	+	+
4.3.2. Interrelations	18	+	+	+
Pillar 5: Nonhuman organism				
5.1. Theory	19	+	+	+
5.2. Basic sciences	20	+	+	+
5.3. Health and well-being	21	+		
Pillar 6: Body and mind				
6.1. Theory	22	+		+
6.2. Basic Sciences	23	+	+	+
6.3. Health and well-being				
6.3.1. Medical sciences	24	+	+	+
6.3.2. Paramedical studies	25	+	+	+
6.3.3. Complementary med.	26	+		
Pillar 7: Society				
7.1. Theory	27	+	+	+
7.2. Society-at-large				
7.2.1. General	28	+	+	+
7.2.2. Area-based	29			
7.3 Domains				
7.3.1. Community				
7.3.1.1. Communication	30	+	+	+
7.3.1.2. Contract	31	+	+	+
7.3.1.3. Codes	32	+	+	+
7.3.1.4. Conduct	33	+	+	+
7.3.2. Needs and activities	34	+	+	+
7.3.3. Management	35	+	+	+
7.4. Social groups				
7.4.1. Gender	36	+		+
7.4.2. Age	37			
7.4.3. Ethnicity	38			
7.4.4. Interest	39	+		
Pillar 8: Thought and art				
8.1. Thought				
8.1.1. Reason	40	+	+	+
8.1.2. Representation	41	+	+	+
8.1.3. Relations	42	+	+	+
8.2. Literature				
8.2.1. Theory	43	+	+	+
8.2.2. Forms	44	+	+	+
8.3. The arts				
8.3.1. Theory	45	+	+	+
8.3.2. Forms	46	+	+	+
Pillar 9: Technology				
9.1. Theory	47	+	+	
9.2. Professions	48	+	+	+
9.3. Technologies				
9.3.1. Sciences	49	+	+	+
9.3.2. Needs and activities	50	+	+	+
9.3.3. Materials	51			
9.3.4. Processes	52			
Pillar 10: History				
10.1. Theory	**53**	+	+	+
10.2. Universal memory	54	+	+	+
10.3. Relations	55	+	+	+

+ Indicates a covered category.

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TABLE 22. The knowledge covered by pillar.

	LCC		DDC		UDC		LCC, DDC, and UDC	
	Complete	Systematic	Complete	Systematic	Complete	Systematic	Complete	Systematic
Pillar 1								
Pillar 2								
Pillar 3	+	+	+	+	+	+	+	+
Pillar 4								
Pillar 5								
Pillar 6								
Pillar 7								
Pillar 8	+	+	+	+	+	+	+	+
Pillar 9								
Pillar 10	+	+	+	+	+	+	+	+
Overall								

+Indicates sufficient coverage; blank indicates insufficient coverage.

following eight categories: 3, 10, 11, 29, 37, 38, 51, and 52. DDC covers the following 43 categories: 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, 23, 24, 25, 27, 28, 30, 31, 32, 33, 34, 35, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 53, 54, and 55. It does not cover the following 14 categories: 2, 3, 15, 19, 21, 22, 26, 29, 36, 37, 38, 39, 51, and 52. UDC covers the following 44 categories: 1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 27, 28, 30, 31, 32, 33, 34, 35, 36, 40, 41, 42, 43, 44, 45, 46, 48, 49, 50, 53, 54, and 55. It does not cover the following 11 categories: 2, 3, 21, 26, 29, 37, 38, 39, 47, 51, and 52.

Two conclusions emerge in the light of these findings. First, none of the three systems is exhaustive, meaning LCC, DDC, and UDC do not comprehensively cover human knowledge. Second, even collectively LCC, DDC, and UDC do not cover the broad spectrum of contemporary knowledge.

Table 22 summarizes how the three systems cover the 10 knowledge domains. Seven of 10 pillars are inadequately covered. The knowledge coverage of pillars 1, 2, 4, 5, 6, 7, and 9 is incomplete and unsystematic. Three pillars are adequately covered. The knowledge coverage of pillars 3, 8, and 10 is complete and systematic. In an overall analysis, none of the three systems adequately present contemporary human knowledge. Furthermore, even taken collectively, LCC, DDC, and UDC fail to adequately present human knowledge.

Methodological Consideration

Scholars who are familiar with the three systems have raised two arguments about the methodology of the study and, consequently, its findings and conclusions. The first argument questions the focus on the top levels of the hierarchical structures. The library schemes may not address the topics outlined in the 10 Pillars of Knowledge at the top levels of each scheme, but nearly all are covered by deeper levels of the schemes.

In fact, at the beginning of the study, we delved into the hierarchical structures and mapped the relevant topics wherever they appeared in each library scheme. However, we decided to leave this practice and focus on the first two levels of the hierarchical structures. We realized that if we go all the way down the hierarchical structures, then each of the systems covers all the topics. Because LCC, DDC, and UDC are aimed at classifying publications, they have to provide a practical solution for every publication. Practically, this means that the three systems cover all topics and all fields. However, very often the practical solutions seem strange. For example, as noted above, veterinary medicine is presented in LCC by the SF (animal culture) subclass, which is a subclass of S (agriculture). Obviously, veterinary medicine is not a subfield of agriculture. Apparently, librarians and users need practical guides to LCC, DDC, and UDC. But developing such guides was not the goal of this study.

A hierarchical classification should meet three conditions. First, the categories are mutually exclusive, meaning they do not overlap one another. Second, the categories are collectively exhaustive, meaning together they comprise all the relevant categories. Third, the classification can represent all the relevant items without exception. This means that every field of knowledge is represented (i.e., can be placed) by at least one category. LCC, DDC, and UDC may meet the third condition and cover all fields of knowledge, but do they meet the first two conditions?

We decided to focus on the first two levels of the hierarchical structures because these levels embody the essence of the classification system. Each level is viewed as an independent classification unit and needs to meet the three conditions. The main classes of each classification (i.e., the first level) need to be mutually exclusive, meaning they do not overlap one another, collectively exhaustive, meaning together they comprise all the relevant classes, and represent all the relevant fields without exception. This means that every field of knowledge is represented by at least one of the main classes.

Each of the main classes establishes an independent classification unit, which comprises main subclasses (i.e., the second level). The main subclasses need to be mutually exclusive, collectively exhaustive, and represent all the relevant fields without exception. This means that every relevant field is represented by at least one of the main subclasses.

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In retrospect, this theoretical-based, methodological decision to focus on the top levels of the hierarchical structures is justified by the findings of the study. The top levels, in many cases, are not systematic.

The second argument questions the focus on the terminology of the hierarchical tree (i.e., classes and subclasses) while ignoring auxiliary tables and application guides. The library systems include auxiliary tables and guiding tools that may refer to all fields of knowledge. Ignoring them affects the findings and conclusions of the study.

In fact, at the beginning of the study, we related to auxiliary tables and tools, but we decided to leave this practice and focus on the terminology of the hierarchical structures. A classification system is a structured network of concepts. The structure is essential as it represents the logical relations among the linked concepts. The terminology is a fundamental element and comprises the structure's building blocks. It needs to be self-explanatory: "What you see is what you get." The auxiliary tools are not part of the structure, but rather explain it. In retrospect, this theoretical-based, methodological decision to focus on the terminology of the systems is justified by the findings of the study. The terminology, in several cases, is biased and misleading.

Conclusions

To determine if a system is unsystematic, we need an exemplary case, and we found numerous examples. To determine if a system is biased, we need an exemplary case, and we found several examples. To determine if a system is incomplete, we need to explore all the levels of the classification. Because we explored the top two levels only, the conclusions regarding the knowledge covered by the three systems refers only to the top two levels.

The inevitable conclusion needs to be explicitly spelled out. The three great library classification systems–LCC, DDC, and UDC–fail to adequately and systematically present contemporary human knowledge. They are unsystematic and biased, and they are incomplete at the top two hierarchical levels. They suffer from critical problems that cannot be resolved by revisions. The time has come to abandon these seminal classifications and construct new constructions.

The study was primarily designed at evaluating the functionality of LCC, DDC, and UDC to adequately represent contemporary human knowledge and to map the knowledge they cover. Because we successfully placed all the relevant classes and subclasses of LCC, DDC, and UDC in at least one category of the 10-pillar model, as a by product, the study reevaluated and showed the adequacy of the 10 Pillars of Knowledge map to represent human knowledge.

Acknowledgement

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Appendix

Main Classes and Subclasses of LCC, DDC, and UDC Mapped in the Study

Library of Congress Classification

Class A – General Works
- Subclass AM Museums. Collectors and collecting
- Subclass AS Academies and learned societies
- Subclass AZ History of scholarship and learning. The humanities

Class B – Philosophy, Psychology, Religion
- Subclass B Philosophy (General)
- Subclass BC Logic
- Subclass BD Speculative philosophy
- Subclass BF Psychology
- Subclass BH Aesthetics
- Subclass BJ Ethics
- Subclass BL Religions. Mythology. Rationalism
- Subclass BM Judaism
- Subclass BP Islam. Bahaism. Theosophy, etc.
- Subclass BQ Buddhism
- Subclass BR Christianity
- Subclass BS The Bible
- Subclass BT Doctrinal Theology
- Subclass BV Practical Theology
- Subclass BX Christian Denominations

Class C – Auxiliary Sciences of History (General)
- Subclass CB History of Civilization
- Subclass CC Archaeology
- Subclass CD Diplomatics. Archives. Seals
- Subclass CE Technical Chronology. Calendar
- Subclass CJ Numismatics
- Subclass CN Inscriptions. Epigraphy
- Subclass CR Heraldry
- Subclass CS Genealogy
- Subclass CT Biography

Class D – World History (except American History)
- Subclass D History (General)
- Subclass DA Great Britain
- Subclass DAW Central Europe
- Subclass DB Austria – Liechtenstein – Hungary – Czechoslovakia
- Subclass DC France – Andorra – Monaco
- Subclass DD Germany
- Subclass DE Greco-Roman World
- Subclass DF Greece
- Subclass DG Italy – Malta
- Subclass DH Low Countries – Benelux Countries
- Subclass DJ Netherlands (Holland)
- Subclass DJK Eastern Europe (General)
- Subclass DK Russia. Soviet Union. Former Soviet Republics – Poland
- Subclass DL Northern Europe. Scandinavia
- Subclass DP Spain – Portugal
- Subclass DQ Switzerland
- Subclass DR Balkan Peninsula
- Subclass DS Asia
- Subclass DT Africa
- Subclass DU Oceania (South Seas)
- Subclass DX Gypsies

Class E – History of the Americas
- [Subclass] 11–143 America
- [Subclass] 151–904 United States

Class F – History of the Americas
- [Subclass] 1–975 United States Local History
- [Subclass] 1001–1145.2 British America (including Canada), Dutch America
- [Subclass] 1170 French America
- [Subclass] 1201–3799 Latin America, Spanish America

Class G – Geography, Anthropology, Recreation
- Subclass G Geography (General). Atlases. Maps
- Subclass GA Mathematical geography. Cartography
- Subclass GB Physical geography
- Subclass GC Oceanography
- Subclass GE Environmental Sciences
- Subclass GF Human ecology. Anthropogeography
- Subclass GN Anthropology
- Subclass GR Folklore
- Subclass GT Manners and customs (General)
- Subclass GV Recreation. Leisure

Class H – Social Sciences
- Subclass H Social sciences (General)
- Subclass HA Statistics
- Subclass HB Economic theory. Demography
- Subclass HC Economic history and conditions
- Subclass HD Industries. Land use. Labor
- Subclass HE Transportation and communications
- Subclass HF Commerce
- Subclass HG Finance
- Subclass HJ Public finance
- Subclass HM Sociology (General)
- Subclass HN Social history and conditions. Social problems. Social reform
- Subclass HQ The family. Marriage. Women
- Subclass HS Societies: secret, benevolent, etc.
- Subclass HT Communities. Classes. Races
- Subclass HV Social pathology. Social and public welfare. Criminology
- Subclass HX Socialism. Communism. Anarchism

Class J – Political Science
- Subclass J General legislative and executive papers
- Subclass JA Political science (General)
- Subclass JC Political theory
- Subclass JF Political institutions and public administration
- Subclass JJ Political institutions and public administration (North America)
- Subclass JK Political institutions and public administration (United States)
- Subclass JL Political institutions and public administration (Canada, Latin America, etc.)
- Subclass JN Political institutions and public administration (Europe)
- Subclass JQ Political institutions and public administration (Asia, Africa, Australia, Pacific Area, etc.)
- Subclass JS Local government. Municipal government
- Subclass JV Colonies and colonization. Emigration and immigration. International migration
- Subclass JX International law, see JZ and KZ (obsolete)
- Subclass JZ International relations

Class K – Law
- Subclass K Law in general. Comparative and uniform law. Jurisprudence
- Subclass KB Religious law in general. Comparative religious law. Jurisprudence
- Subclass KBM Jewish law
- Subclass KBP Islamic law
- Subclass KBR History of canon law
- Subclass KBU Law of the Roman Catholic Church. The Holy See
- Subclasses KD-KDK United Kingdom and Ireland
- Subclass KDZ America. North America

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Library of Congress Classification (*Continued*)

- Subclass KE Canada
- Subclass KF United States
- Subclass KG Latin America – Mexico and Central America – West Indies. Caribbean area
- Subclass KH South America
- Subclasses KJ-KKZ Europe
- Subclasses KL-KWX Asia and Eurasia, Africa, Pacific Area, and Antarctica
- Subclass KZ Law of nations

Class L – Education
- Subclass L Education (General)
- Subclass LA History of education
- Subclass LB Theory and practice of education
- Subclass LC Special aspects of education
- Subclass LD Individual institutions - United States
- Subclass LE Individual institutions - America (except United States)
- Subclass LF Individual institutions - Europe
- Subclass LG Individual institutions - Asia, Africa, Indian Ocean islands, Australia, New Zealand, Pacific islands
- Subclass LH College and school magazines and papers
- Subclass LJ Student fraternities and societies, United States
- Subclass LT Textbooks

Class M – Music
- Subclass M Music
- Subclass ML Literature on music
- Subclass MT Instruction and study

Class N – Fine arts
- Subclass N Visual arts
- Subclass NA Architecture
- Subclass NB Sculpture
- Subclass NC Drawing. Design. Illustration
- Subclass ND Painting
- Subclass NE Print media
- Subclass NK Decorative arts
- Subclass NX Arts in general

Class P – Language and Literature
- Subclass P Philology. Linguistics
- Subclass PA Greek language and literature. Latin language and literature
- Subclass PB Modern languages. Celtic languages
- Subclass PC Romanic languages
- Subclass PD Germanic languages. Scandinavian languages
- Subclass PE English language
- Subclass PF West Germanic languages
- Subclass PG Slavic languages. Baltic languages. Albanian language
- Subclass PH Uralic languages. Basque language
- Subclass PJ Oriental languages and literatures
- Subclass PK Indo-Iranian languages and literatures
- Subclass PL Languages and literatures of Eastern Asia, Africa, Oceania
- Subclass PM Hyperborean, Indian, and artificial languages
- Subclass PN Literature (General)
- Subclass PQ French literature – Italian literature – Spanish literature – Portuguese literature
- Subclass PR English literature
- Subclass PS American literature
- Subclass PT German literature – Dutch literature – Flemish literature since 1830 – Afrikaans literature – Scandinavian literature – Old Norse literature: Old Icelandic and Old Norwegian – Modern Icelandic literature – Faroese literature – Danish literature – Norwegian literature – Swedish literature
- Subclass PZ Fiction and juvenile belles letters

Class Q – Science
- Subclass Q Science (General)
- Subclass QA Mathematics
- Subclass QB Astronomy
- Subclass QC Physics
- Subclass QD Chemistry
- Subclass QE Geology
- Subclass QH Natural history – Biology
- Subclass QK Botany
- Subclass QL Zoology
- Subclass QM Human anatomy
- Subclass QP Physiology
- Subclass QR Microbiology

Class R – Medicine
- Subclass R Medicine (General)
- Subclass RA Public aspects of medicine
- Subclass RB Pathology
- Subclass RC Internal medicine
- Subclass RD Surgery
- Subclass RE Ophthalmology
- Subclass RF Otorhinolaryngology
- Subclass RG Gynecology and obstetrics
- Subclass RJ Pediatrics
- Subclass RK Dentistry
- Subclass RL Dermatology
- Subclass RM Therapeutics. Pharmacology
- Subclass RS Pharmacy and materia medica
- Subclass RT Nursing
- Subclass RV Botanic, Thomsonian, and eclectic medicine
- Subclass RX Homeopathy
- Subclass RZ Other systems of medicine

Class S – Agriculture
- Subclass S Agriculture (General)
- Subclass SB Plant culture
- Subclass SD Forestry
- Subclass SF Animal culture
- Subclass SH Aquaculture. Fisheries. Angling
- Subclass SK Hunting sports

Class T – Technology
- Subclass T Technology (General)
- Subclass TA Engineering (General). Civil engineering
- Subclass TC Hydraulic engineering. Ocean engineering
- Subclass TD Environmental technology. Sanitary engineering
- Subclass TE Highway engineering. Roads and pavements
- Subclass TF Railroad engineering and operation
- Subclass TG Bridge engineering
- Subclass TH Building construction
- Subclass TJ Mechanical engineering and machinery
- Subclass TK Electrical engineering. Electronics. Nuclear engineering
- Subclass TL Motor vehicles. Aeronautics. Astronautics
- Subclass TN Mining engineering. Metallurgy
- Subclass TP Chemical technology
- Subclass TR Photography
- Subclass TS Manufactures
- Subclass TT Handicrafts. Arts and crafts
- Subclass TX Home economics

Class U – Military Science
- Subclass U Military science (General)
- Subclass UA Armies: Organization, distribution, military situation
- Subclass UB Military administration
- Subclass UC Maintenance and transportation
- Subclass UD Infantry
- Subclass UE Cavalry. Armor
- Subclass UF Artillery
- Subclass UG Military engineering. Air forces
- Subclass UH Other services

Class V – Naval Science
- Subclass V Naval science (General)
- Subclass VA Navies: Organization, distribution, naval situation
- Subclass VB Naval administration

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Subclass VC Naval maintenance
Subclass VD Naval seamen
Subclass VE Marines
Subclass VF Naval ordnance
Subclass VG Minor services of navies
Subclass VK Navigation. Merchant marine
Subclass VM Naval architecture. Shipbuilding. Marine engineering
Class Z – Bibliography, Library Science
Subclass Z Books (General). Writing. Paleography. Book industries and trade. Libraries. Bibliography
Subclass ZA Information resources (General)

Dewey Decimal Classification

000 Computer science, knowledge & systems
020 Library & information sciences
060 Associations, Organizations, Museums
070 News media, journalism & publishing
100 Philosophy
110 Metaphysics
120 Epistemology
130 Parapsychology & occultism
140 Philosophical schools of thought
150 Psychology
160 Logic
170 Ethics
180 Ancient, medieval & eastern philosophy
190 Modern western philosophy
200 Religion
210 Philosophy & theory of religion
220 The Bible
230 Christianity & Christian theology
240 Christian practice & observance
250 Christian pastoral practice & religious orders
260 Christian organization, social work & worship
270 History of Christianity
280 Christian denominations
290 Other religions
300 Social sciences, sociology & anthropology
310 Statistics
320 Political science
330 Economics
340 Law
350 Public administration & military science
360 Social problems & social services
370 Education
380 Commerce, communications & transportation
390 Customs, etiquette & folklore
400 Language
410 Linguistics
420 English & Old English languages
430 German & related languages
440 French & related languages
450 Italian, Romanian & related languages
460 Spanish & Portuguese languages
470 Latin & Italic languages
480 Classical & modern Greek languages
490 Other languages
500 Science
510 Mathematics
520 Astronomy
530 Physics
540 Chemistry
550 Earth sciences & geology
560 Fossils & prehistoric life
570 Life sciences; biology
580 Plants (Botany)
590 Animals (Zoology)
600 Technology
610 Medicine & health
620 Engineering
630 Agriculture
640 Home & family management
650 Management & public relations
660 Chemical engineering
670 Manufacturing
680 Manufacture for specific uses
690 Building & construction
700 Arts
710 Landscaping & area planning
720 Architecture
730 Sculpture, ceramics & metalwork
740 Drawing & decorative arts
750 Painting
760 Graphic arts
770 Photography & computer art
780 Music
790 Sports, games & entertainment
800 Literature, rhetoric & criticism
810 American literature in English
820 English & Old English literatures
830 German & related literatures
840 French & related literatures
850 Italian, Romanian & related literatures
860 Spanish & Portuguese literatures
870 Latin & Italic literatures
880 Classical & modern Greek literatures
890 Other literatures
900 History
910 Geography & travel
920 Biography & genealogy
930 History of ancient world (to ca. 499)
940 History of Europe
950 History of Asia
960 History of Africa
970 History of North America
980 History of South America
990 History of other areas

Universal Decimal Classification

0 Generalities
00 Prolegomena. Fundamentals of knowledge and culture. Computer science.
01 Bibliography and bibliographies. Catalogues
02 Librarianship
06 Museums
070 Journalism
08 Polygraphies
1 Philosophy. Psychology
101 Nature and role of philosophy
11 Metaphysics
13 Philosophy of mind
14 Philosophical systems
159.9 Psychology
16 Logic. Epistemology
17 Moral philosophy. Ethics
2 Religion. Theology
21 Prehistoric and primitive religions
22 Religions of the Far East
23 Religions of the Indian subcontinent
24 Buddhism

(*Continued*)

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Universal Decimal Classification (*Continued*)

- 25 Religions of antiquity. Minor cults and religions
- 26 Judaism
- 27 Christianity
- 28 Islam
- 29 Modern spiritual movements

3 Social Sciences

- 30 Theories and methods in social sciences
- 31 Demography. Statistics. Sociology
- 32 Politics
- 33 Economics
- 34 Law. Jurisprudence
- 35 Public administration
- 36 Social Welfare
- 37 Education
- 39 Ethnography. Customs. Manners. Traditions. Way of life. Folklore

5 Mathematics and Natural Sciences

- 50 Generalities about the pure sciences
- 51 Mathematics
- 52 Astronomy. Astrophysics. Space research. Geodesy
- 53 Physics
- 54 Chemistry. Crystallography. Mineralogy
- 55 Earth sciences. Geology, meteorology, etc.
- 56 Palaeontology
- 57 Biological sciences in general
- 58 Botany
- 59 Zoology

6 Applied Sciences. Medicine. Technology

- 60 Biotechnology
- 61 Medical sciences
- 62 Engineering. Technology in general
- 63 Agriculture and related sciences and techniques. Forestry. Farming. Wildlife exploitation
- 64 Home economics. Domestic science. Housekeeping
- 65 Communication and transport industries. Business management. Public relations
- 66 Chemical technology. Chemical and related industries
- 67 Various industries, trades and crafts
- 68 Industries, crafts and trades for finished or assembled articles
- 69 Building (construction) trade. Building materials. Building practice and procedure

7 The Arts. Recreation. Entertainment. Sport

- 71 Physical planning. Regional, town and country planning
- 72 Architecture
- 73 Plastic arts
- 74 Drawing. Design, applied arts and crafts
- 75 Painting
- 76 Graphic art. Graphics
- 77 Photography and similar processes
- 78 Music
- 79 Recreation. Entertainment. Games. Sport

8 Language. Linguistics. Literature

- 80 General questions. Including: Philology. Rhetoric
- 81 Linguistics and languages
- 82 Literature

9 Geography. Biography. History

- 91 Geography. Exploration
- 929 Biographical and related studies
- 93/94 History. Science of history. Ancillary sciences. General history

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