UDC Seminar
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Relationships in the Notational Hierarchy of the Dewey Decimal Classification

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Outline

- Context
  - Rationale
  - Hierarchical relationships in DDC
- Study
- Transformation into shared formalism
  - Using OWL to construct meta-language/vocabulary
  - Using OWL itself as meta-language
- Conclusion
  - Areas for future investigation
  - Use

Context

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Rationale for study

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- Part of larger, ongoing assessment of relationships in the DDC
  - Goal: More logical, powerful representation of system
  - Means: Transformation of classification scheme to ontological structure
- Hierarchical relationships as the structural backbone enabling the basic/initial aspect of transformation
- Can relationships in DDC notational hierarchy support such a transformation?

Hierarchical relationships in DDC: Notational hierarchy

Class number	Caption
500	Natural sciences and mathematics
510	Mathematics
516	Geometry
516.2	Euclidean geometry
516.24	Trigonometry
516.242	Plane trigonometry

Hierarchical relationships in DDC: Centered entries

Class number	Caption
700	The arts
780	Music
781-788	Principles, forms, ensembles, voices, instruments
784-788	Instruments and their music
784	Instruments and instrumental ensembles and their music
784.1	General principles, musical forms, instruments
784.18	Musical forms
784.182-784.189	Specific musical forms
784.183-784.189	Instrumental forms
784.184	Symphonies
784.184 3	Symphonic poems

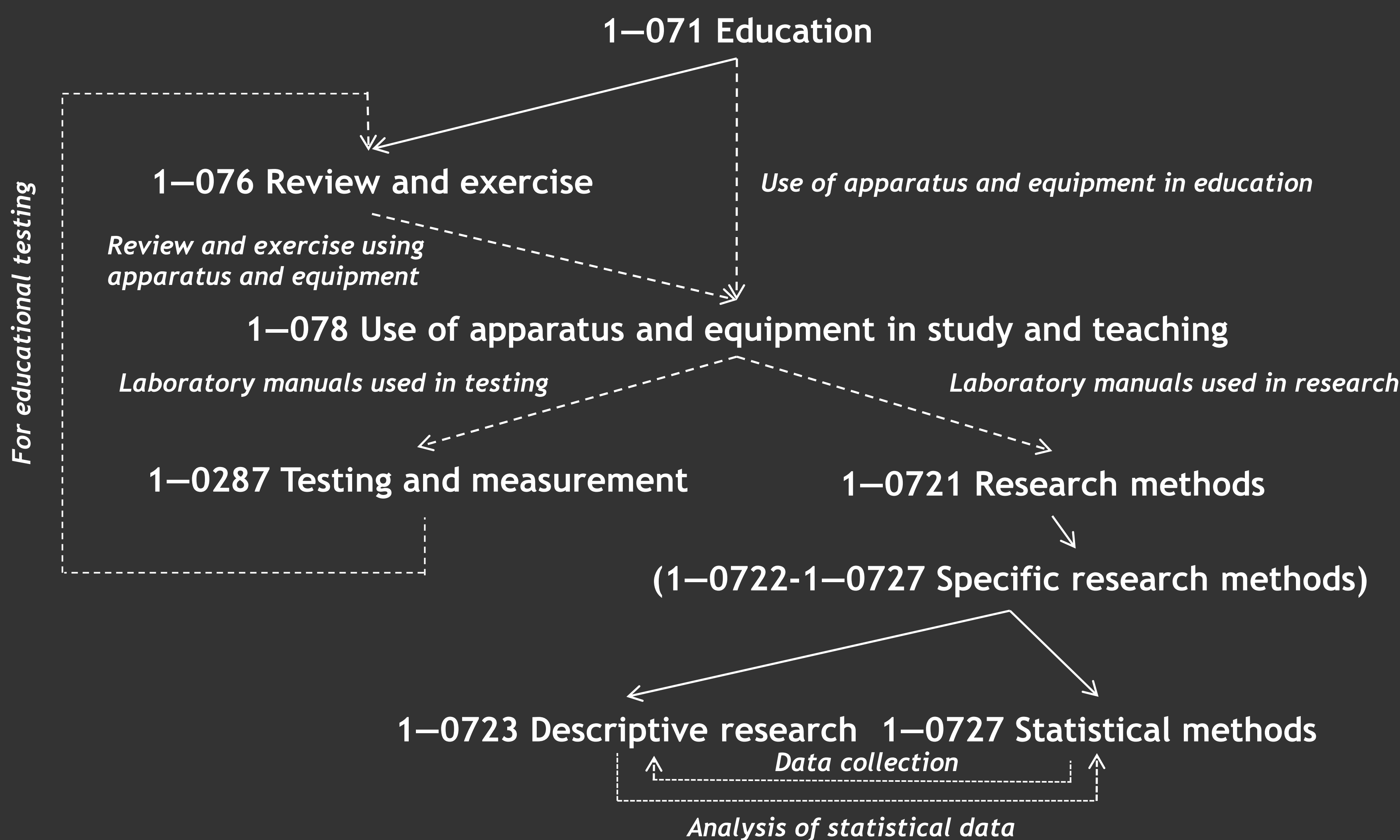
Hierarchical relationships in DDC: Structural hierarchy

302.222 3 Symbols

Class here interdisciplinary works on symbols, on symbolism

For religious symbolism, see 203.7; for Christian religious symbols, see 246.55. For symbols in a specific subject other than religion, see the subject, plus notation 0148 from Table 1, e.g., symbols in electrical engineering 621.30148

Hierarchical relationships in DDC: Structural hierarchy chain



Hierarchical relationships in DDC: Hierarchical force

- Whatever is true of general topic also true of subordinate topics
- Notes with hierarchical force:

Definition notes	Variant-name, former-name notes
Scope notes	Class-here notes
Number-built notes	Class-elsewhere notes
Former heading notes	See references

Hierarchical relationships in DDC: Relative Index headings

LDR		nz###n##
001		och00037370
003		OCoLC-D
005		20101117233831.0
008		100206|||a|z||||||##########||#a||#####d
040	##	$a OCoLC-D $b eng $c OCoLC-D $d OCoLC-D $f ddcri
083	04	$a 365.34 $0 (OCoLC-D)ocd00140467 $2 23 $5 OCoLC-D $9 as=AP $9 ps=PE
150	##	$a Detention homes
550	##	$w g $a Penal institutions $0 (OCoLC-D)och00092908 $2 23 $9 ra=AP $9 rv=PE

Detention homes 365.34
see also Penal institutions

Study

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Methodology

- Random sample of 200 parent-child pairs (according to notational hierarchy)
- Set of relationship types (developed and tested in preliminary rounds)
- Two judges/raters, working independently

Hierarchical relations in KOS / DDC

Relationship type	Elaboration
Generic	Kind-of relationship All-and-some test applies
Instance	Individual instance of category
Whole-part	Compositional relationship Admits various subtypes

*ANSI/NISO *Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies* (2005)

- DDC supports these same relationship types
- No systematic way of distinguishing among them

Hierarchical relations in OWL

- Generic relationship
  - Subclass axiom “allows one to state that each instance of one class expression is also an instance of another class expression”
  - Transitive and reflexive
- Instance relationship
  - Possible to assert that individual is instance of class
  - Class-related axioms operate on sets of individuals / instances of classes, not on classes themselves
- Whole-part relationship
  - No built-in primitives for this type of relationship
  - Possible to handle most whole-part logic through assertions

Relationship types for study

Relationship type	Elaboration
Specialization	Differentiating property Additional facet/entity-type involved
Class-instance	Individual Subclass
Whole-part*	Mass/quantity Element/collection Component/complex Segment Portion

*Based on Gerstl, P.; Pribbenow, S. (1995). Midwinters, end games, and body parts: a classification of part-whole relations. *International Journal of Human-Computer Studies*, 43, pp. 865-889.

Relationship type examples

Relationship type	Elaboration	Example
Specialization	Differentiating property	321.02-321.08 Kinds of states *vs.* 321.06 Small states
Specialization	Additional entity-type involved	798.2 Ballet and modern dance *vs.* 798.209 History, geographic treatment, biography
Class-instance	Individual	224 Prophetic books of Old Testament *vs.* 224.8 Amos
Class-instance	Subclass	687.1 Specific kinds of garments *vs.* 687.14 Outerwear

Relationship type examples—*cont*.

Relationship type	Elaboration	Example
Whole-part	Mass/quantity	[783.12–783.19 Ensembles by size *vs.* 783.13 Trios]
Whole-part	Element/ collection	571.63 Cell anatomy, morphology, biophysics, culture *vs.* 571.633 Cell anatomy and morphology
Whole-part	Component/ complex	642 Meals and table service *vs.* 642.8 Table decorations
Whole-part	Segment	[551.513–551.514 Atmospheric regions *vs.* 551.514 Upper atmosphere]
Whole-part	Portion	971 Canada *vs.* 971.6 Nova Scotia

Results

	Both judges assigned a single/definitive relationship type and elaboration	One or both judges made multiple, incomplete and/or uncertain assignments
Agreement between judges on relationship and elaboration	Table 1 (62%)	Table 4 (11%)
Agreement between judges on relationship, but not elaboration	Table 2 (3%)	Table 5 (4%)
Disagreement between judges on relationship and elaboration	Table 3 (5%)	Table 6 (14%)

Results (2)

Table 1—*Agreement between judges on relationship and elaboration (set 1)*

Relationship + Elaboration	Freq
Specialization + [property/entity]	37
Class-instance + Individual	12
Class-instance + Subclass	9
Whole-part + Component/complex	8
Whole-part + Element/collection	12
Whole-part + Portion	64

Results (3)

- No additional relationship types needed
- Confusion between:
  - Specialization
  - Class-instance: subclass
  - Whole-part: element/collection
- Possible resolutions
  - Eliminate class-instance: subclass
  - Impose IS-A test

Transformation into Shared Formalism

Shared formalism?

- Ontology not just abstract conceptualization, but dependent on knowledge representation language
- Choice of language facilitates and constrains formalization of a KOS
- KOS relationships may have to be interpreted in a formalism as semantic elements
    - of the representation language itself
    - of the represented knowledge base (the ontology)

Using OWL to describe KOS (1)

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- Two basic approaches
  1. Using OWL to construct meta-language/vocabulary
     - OWL semantics are used only for building the meta-language, not for the specific KOS
     - Example: SKOS
     - SKOS is used to describe a specific KOS
     - Consequence: semantic relationship defined by SKOS do not share implications of their OWL “relatives” (owl:subClassOf vs. skos:broader)
     - End result: SKOS as ontology, KOS as instance data

Using OWL to describe KOS (2)

- Two basic approaches
  2. Using OWL itself as meta-language
     - Direct access to OWL semantics for describing KOS
     - Consequence: alignment required of semantic relationships present in KOS to those in OWL
     - End result: KOS as ontology

OWL as meta-language: Consequences for hierarchical relationships

OWL requires commitment to

- subClassOf as only hierarchical relationship
  - Axiom of OWL's model theoretic semantics
  - Relates individuals to other individuals
- Instance relationship as non-hierarchical
  - Part of OWL's embedded constructs
  - "Relates" individuals and classes
- Whole-part relationship as defined by the ontology

OWL as meta-language for classification systems (1)

- Pros
  - Shared notion of “class” as one basic entity
  - Basic compatibility of specialization relationship to subclass hierarchies
- Cons
  - Identification of true specialization relationships not trivial
  - No direct correspondence of other relationships types
  - Compatibility of class-instance notions not certain
    - Open question: What counts as instance data of a classification system formalized in OWL?

OWL as meta-language for classification systems (2)

- Benefits of strong typing of at least some specialization relationships
  - Usage of well-defined semantics for generic relationship
  - Chains of generically connected classes useful for inferencing, automatic classification, retrieval
  - Expressing characteristic used for creating subclasses explicitly could help isolate facets throughout the classification

Conclusion

Areas for future investigation

- Use of whole-part: element-collection
- Specialization by entity type
- Logic of relationship types
- Topics (identification, representation)

Use

- Improve the DDC
  - Identify and fix structural problems
  - Support efficient maintenance of system
  - Promote end-user discovery