An Ontology Based Research Guide for Educational Research

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Who are we?

Main Fields of Action
- Educational Research
- Educational Information
  - Information Center for Education
  - Libraries for Educational History and Educational Research

Information Center for Education
- Databases
- Information portals and services
- Technology Based Assessment
- Information Science Research
Research Guide : Objectives

Use of Semantic Web Technologies
- Ontologies
- Inference mechanisms
- Semantic search

.. for the Integration of our Data Sources
- Heterogeneous databases
- Thesaurus
- Pedagogics taxonomy

... with the aims of
- semantically integrating the data sources by an ontology
- expanding the knowledge base by inference rules
- providing semantic search functionalities

An Ontology based Research Guide for Educational Research
Our data sources

Documents
Authors
Descriptors

German Education Index
(FIS Bildung Literatordatenbank)

Persons
Fields of research
Persons database

Institutions
Fields of research
Institutions database

Projects
Fields of research

Innovation database

Thesaurus

Pedagogics taxonomy

1
1.1
1.1.1
1.1.2
1.1.3
1.2
1.2.1
1.2.2
1.2.2
Current use of data sources

Thesaurus
- Not used for search support

Pedagogics taxonomy
- Not used for document classification

Other data sources
- No connection between Persons database and German Education Index
- No connection between Thesaurus and Institutions database
Potential of SemWeb technologies

Integration
- Semantic and structural data integration based on an ontology

Knowledge expansion
- Enrichment of the knowledge base by rule based inference mechanisms

Semantic search
- Development of semantic search functionalities for querying the ontologically structured knowledge base

Interoperability
- Future interoperability with external applications based on Semantic Web standards
Ontology Engineering

Define Ontology schema

- Formal conceptualization of the domain of educational research
- Reuse of existing ontologies (e.g. SWRC)
  (Sure et al. 2005)

Map Ontology instances

- Mapping of instance data from the original data sources to the ontology

Apply Inference rules

- Definition of rules in the „Semantic Web Rule Language“ (SWRL)
  (O’Connor et al. 2005)
Ontology schema

Part of the extended SWRC ontology

- models research communities
- enhanced by own vocabulary
Ontology instances

Mapping of instance data from the original data sources to the ontology

- Persons
- Projects
- Research Topics
- ...
Inference Rules

Example

- Project „has Research Topic“ Research Topic
- Research Topic „is subclass of“ different Research Topic

→ Project does research on both topics
Ontology based Data Integration I

Example
- Modeling of subrelations
- `swrc:email` is enhanced by two more specific subrelations

Example
```
Person
<table>
<thead>
<tr>
<th>Last name</th>
<th>Private email</th>
<th>Business email</th>
<th>...</th>
</tr>
</thead>
</table>
```

Diagram:
- `swrc:Person`
  - `swrc:email`
  - `v:privateEmail`
  - `v:businessEmail`
- Types: `string`
Ontology based Data Integration II

Example

- Contents of the 2 tables „Person“ and „Author“ are merged
- „Author“ is modeled as a subclass of „Person“
- The subclass inherits the properties of the superclass

```
<table>
<thead>
<tr>
<th>First name</th>
<th>Last name</th>
<th>…</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>First name</th>
<th>Name</th>
<th>…</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
Search components I

Instance search
- Projects
- School research
- Persons
- Documents

Free text search
- Klieme, school research

Logics based search
- Project
  - has Topic
- Person
  - has Research Topic
- School Research
  - TBA
  - E-Learning

- swrc:Project
  - DESI
  - swrc:member
  - v:hasResearchTopic
  - Teaching research

- swrc:ResearchTopic
  - School research
  - owl:subclassOf
  - v:hasResearchTopic
Search Components II

Browsing of Dynamic Websites
- Relationships between ontology instances are displayed on dynamic websites

<table>
<thead>
<tr>
<th>Project: DESI</th>
<th>Research Topic: School research</th>
<th>Person: Klieme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons</td>
<td></td>
<td>Projects</td>
</tr>
<tr>
<td>Klieme</td>
<td></td>
<td>DESI</td>
</tr>
<tr>
<td>Hartig</td>
<td></td>
<td>PISA</td>
</tr>
<tr>
<td>Research Topics</td>
<td></td>
<td>Research Topics</td>
</tr>
<tr>
<td>School research</td>
<td></td>
<td>School research</td>
</tr>
<tr>
<td>Subclasses</td>
<td></td>
<td>Teaching research</td>
</tr>
</tbody>
</table>
Expected Surplus values

Integration
- Semantic and structural data integration

Data enrichment
- Detection of new relationships that are not explicitly stated in the original data sources

Cleansing
- Data cleansing by inferencing

Retrieval
- Ontology based retrieval support
## Further Fields of Interest

### Evaluation of surplus values
- Use cases for retrieval scenarios

### Ontology enrichment by web mining techniques
- Information extraction from (semi-)structured internet resources

### Exposure of change processes
- E.g. “is employed by” → “was employed by”

### Illustration of relation strengths
- E.g. the number of a person’s publications in a certain research field has an impact on the strength of the relation “has Research Topic”

### Basis for bibliometric analyses
- The number of relations between two ontology objects can be interpreted as the relation intenseness
Thank you for your attention!