

# EduCOR: An Educational and Career-Oriented Recommendation Ontology

Ilkou E.<sup>1,2</sup>, Abu-Rasheed H.<sup>3</sup>, Tavakoli M.<sup>1,2,4</sup>, Hakimov S.<sup>4</sup>,  
Kismihók G.<sup>4</sup>, Auer S.<sup>4</sup>, Nejdl W.<sup>1,2</sup>

<sup>1</sup>L3S Research Center

<sup>2</sup>Leibniz University of Hannover

<sup>3</sup>WBS & WM Institute, University of Siegen

<sup>4</sup>TIB – Leibniz Information Centre for Science and Technology

ISWC 2021

# The problem

## ERs and OERs

- ▶ low-quality metadata [1]
- ▶ isolated from content-wise similar resources
- ▶ lacking of high-quality services based on OERs [2]

## Schemata and vocabularies

- ▶ lack of online availability
- ▶ lack of ability to accommodate personalised recommendations of OERs

## No model available for connecting:

- ▶ angles of education
- ▶ labour market
- ▶ individual needs of learners

# Who is interested?

## SW community

- ▶ personalised recommendations and QnA
- ▶ metadata [3, 4] and data availability
- ▶ Educational KGs [5, 6, 7]

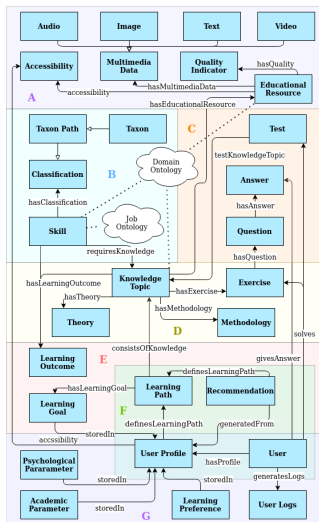
## Education side

- ▶ enrich tools with AI (smart tutoring systems) [8]
- ▶ personalised learning recommendations [9, 10]

## Broader community

- ▶ online learning, life long learning and career changes [11, 12]
- ▶ digital transformation of education<sup>1</sup>
- ▶ ERs and OERs repositories

<sup>1</sup>[https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan\\_en](https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en)

EduCOR  
ontology

# Development phases

Requirement analysis for e-learning platforms to host personalised recommendations:

- ▶ Reviewing the literature
- ▶ Existing e-learning system

Expert evaluation phase:

- ▶ Domain expert
- ▶ Ontology experts

# Ontology Composition

- ▶ Publicly available, findable, and registered
- ▶ IEEE LOM Standard<sup>2</sup>
- ▶ LRMI Standard<sup>3</sup>
- ▶ Reusing Curriculum Course Syllabus Ontology (CCSO)[13], and schema.org<sup>4</sup>
- ▶ Licence: CC0 1.0
- ▶ FAIR principles
- ▶ Plug-in points with other ontologies
- ▶ Used as a whole or as parts via the patterns

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<sup>2</sup><https://standards.ieee.org/standard/1484121-2020.html>

<sup>3</sup><https://www.dublincore.org/specifications/dublin-core/dces>

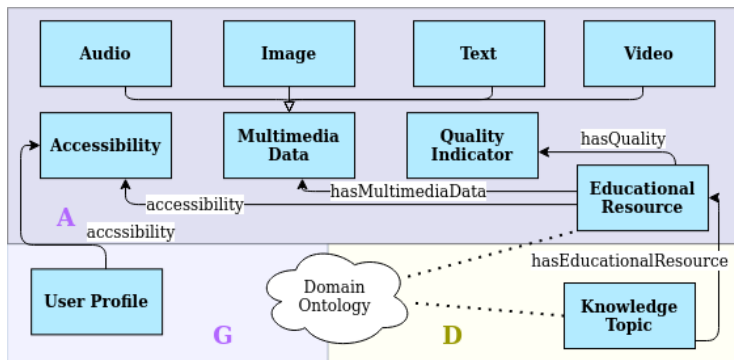
<sup>4</sup><https://schema.org/>

# Patterns

Based on the requirement analysis, we identified patterns:

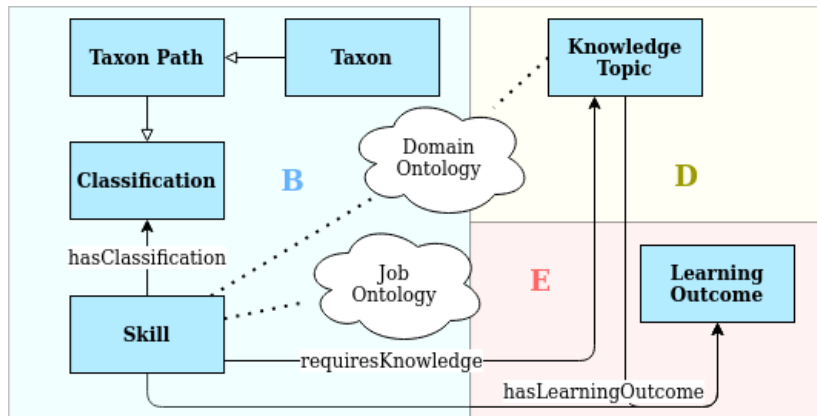
1. Educational Resource
2. Skill
3. Test
4. Knowledge Topic
5. Learning Path
6. Recommendation
7. User Profile

# Educational Resource pattern

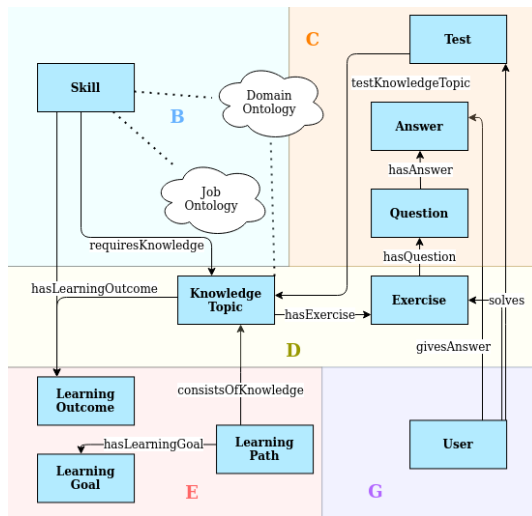




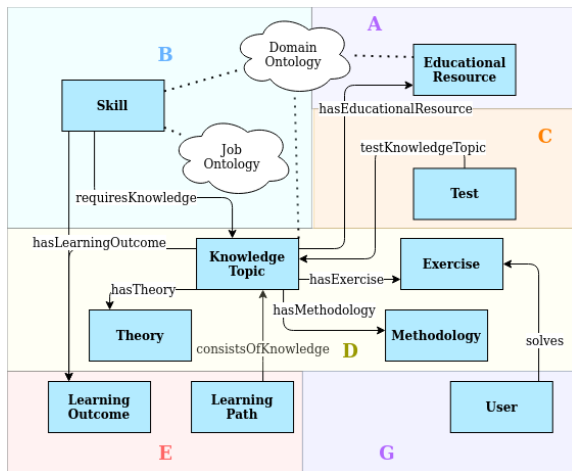
# Skill pattern



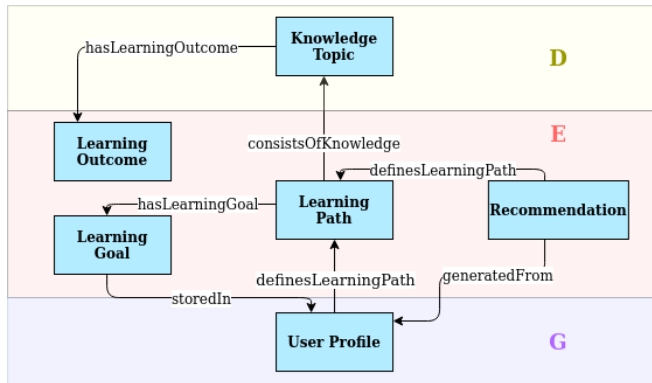
# Test pattern



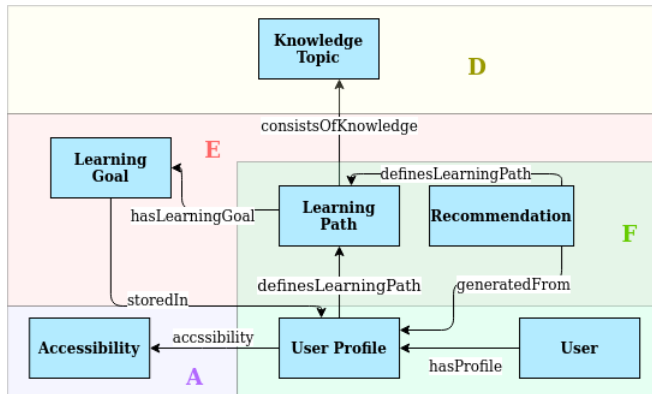
# Knowledge Topic pattern



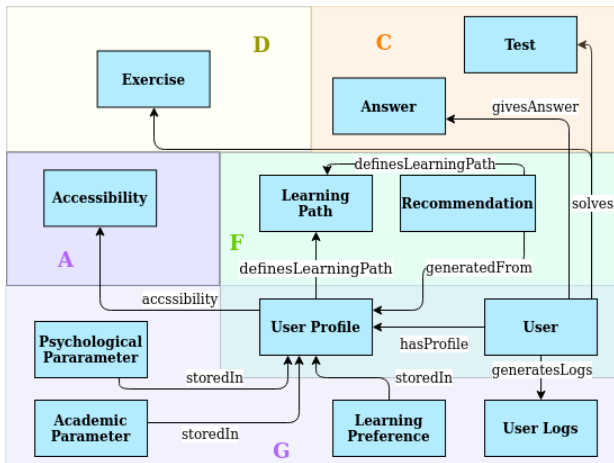
# Learning Path pattern



# Recommendation pattern



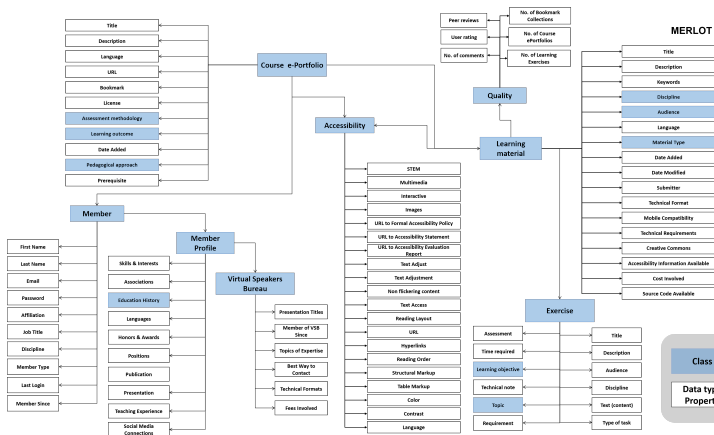
# User Profile pattern



# Evaluation

# General Use Case

## Repository owner/developer





# Specific Use Case

## eDoer platform

The screenshot displays the eDoer platform interface. On the left is a dark sidebar with a 'Dashboard' header and a menu containing: Profile, My Goals, Curriculum, Assessment, History, Search, and Discover. The main content area has a breadcrumb trail 'Discover / Skills / Machine learning with python' and a title 'Machine learning with python' with a chat icon. Below the title, there are two main panels. The left panel, 'Topics in this skill', lists five topics: 'Supervised learning vs unsupervised learning', 'Regression vs classification', 'Linear regression', 'Linear regression with scikit', and 'Gradient descent'. Each topic has a message icon and a 'Votes' section with up/down arrows and a red circle. The right panel, 'Related Jobs', lists three jobs: 'Data Scientist with Python In Professional, Scientific, and Technical Activities', 'Data Scientist with Python In Human Health and Social Work', and 'Data Scientist with Python In Wholesale and Trade Retail'. Each job also has a message icon and a 'Votes' section. At the bottom of the 'Topics in this skill' panel, there are four teal buttons: 'ADD suggestions', 'DELETE suggestions', 'REORDER suggestions', and 'EDIT suggestions', each with a 'Votes' label. A vertical orange 'Feedback' button is on the far right. At the bottom of the screen, there is a navigation bar with various icons for navigation and search.

# Ontology Evaluation

A recent survey [14] classified evaluation:

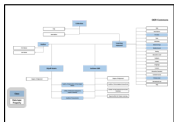
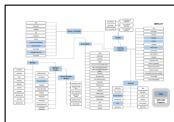
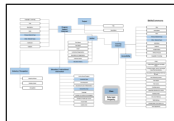
1. Gold-standard based
2. Corpus-based or data-driven
3. Task-based of Application-based
4. Criteria-based
5. Evaluation by humans

To ensure objectivity [15, 16] based on [17, 18], we focus on **coverage** and **adaptability** as key performance indicators (KPIs) of the EduCOR ontology. Based on these two KPIs, we conduct the evaluation approaches of:

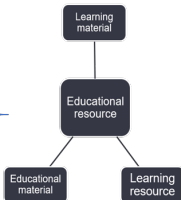
- ▶ Gold-standard
- ▶ Task-based

# Gold Standard-Based Evaluation

Schema Extraction



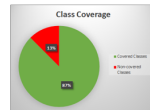
Class Name Analysis



Class Mapping

OER Commons	EduCOR
Collection	
Learning resource	EducationalResource
Material Type	MultimediaData
Media Format	MultimediaData
Evaluation Achieve OER	QualityIndicator
Evaluation EQUIP Rubric	QualityIndicator
Author	User
Primary User	User
Provider	User
Quality of Assessments	QualityIndicator
Quality of Explanation of the Subject Matter	QualityIndicator
Utility of Materials	
Designed to Support Teaching	

Recall Calculation



$$Recall = \frac{TP}{TP + FN}$$

# Gold Standard-Based Evaluation

**Table 1.**

Recall values of EduCOR as calculated for each gold schema

	<b>OER-Commons</b>	<b>SkillsCommons</b>	<b>Merlot</b>
EduCOR ontology	0.833	0.857	0.875

# Task-Based Evaluation

From the use case, we define three main tasks that EduCOR should fulfill:

1. Adaptable representation of OERs from multiple sources.
2. Consideration of labour market skills in the learning path.
3. User-centred design, considering learner's academic and psychological needs within the user profile.

## Task-Based Evaluation

To evaluate EduCOR's ability of performing these tasks, the following set of questions were designed:

- ▶ Q1: How to retrieve OERs from multiple sources for a learning goal?
- ▶ Q2: How can a personalized OER difficulty be chosen for the user?
- ▶ Q3: How to provide an OER to a user with a specific access mode?
- ▶ Q4: How to retrieve required OERs for a certain job skill?
- ▶ Q5: What is required to generate a personalized learning path?
- ▶ Q6: How to personalize a learning recommendation based on a user's psychological state?

## State of the art

# Areas of interest

- ▶ General educational domain ontologies
- ▶ Personalised recommendation systems in e-learning
- ▶ User modeling



# Related work comparison to ours

Paper	FAIR	Evaluation	Data availability	Personalisation	Reuse of vocabularies
[7]	No	Yes	Yes	Goals (Learning goals)	No
[18]	No	No	No	Learning preferences, Learning style, Learner characteristics, Knowledge level, Learning activities	W3C recommendation ontology
[19]	No	Yes	No	Education information, Job related skills	No
[23]	No	No	No	Learning Style, Learning pathways	IEEE LOM
[26]	No	Yes	No	Datatype properties	IEEE LOM, thesauri, SKOS
[29]	No	Yes	No	Accessibility, Activities, Health conditions	No
[38]	No	No	No	Learning pathways	No
Ours	Yes	Yes	Yes	Learning Goal, Learning pathways, Accessibility, Learning preferences, Psychological parameter, Academic parameter, Recommendation, Datatype properties	IEEE LOM, CCSO, DCMI, SKOS, schema.org

# Conclusion

# Discussion

## Can do

- ▶ be used as a whole or as parts via the patterns
- ▶ fit in different educational domains
- ▶ rich metadata
- ▶ compatibility with existing educational repositories

## Cannot do

- ▶ provide data to specific educational domain (expert intervention)
- ▶ automatic mapping
- ▶ automatic alignment

# Future Steps

- ▶ Automatic alignment
- ▶ Quality indicators
- ▶ Learning preferences
- ▶ Accessibility analysis
- ▶ User's privacy
- ▶ Open Educational KG

# Acknowledgements

Partners:



Supporters:



# Thank you for your attention

For questions or comments please contact  
**ilkou@l3s.de**

Find us on GitHub



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