GeoCourseHub Ontology: Towards Lifelong Curriculum Management

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Keywords
curriculum ontology, individual learning path, reusable education, body of knowledge

1. Project background

Initiated in 2022 by the University of Twente's Faculty of Geo-Information Science and Earth Observation (ITC), the GeoCourseHub (GCH) project (https://gch.utwente.nl/) is centered around the development and implementation of a novel educational platform. It was designed to facilitate the management of curriculum metadata. This project was launched to consolidate information resources on ITC's educational offerings and provide an information backend, a single point of access to semantically rich curriculum metadata for different parties and use cases. This effort aims to:

- improve flexibility in building new courses and updating existing ones
- enable management of education offerings, i.e., finding course content, identifying overlaps and gaps
- support personalized learning paths for customised learning
- creating courses collaboratively with partner universities and knowledge institutes
- provide a single point of access to curriculum information.

The project has already shown its potential. As a part of the Ingenuity program, GCH plays a supportive role in a sister Ingenuity project, namely Geoversity [1], an online course dissemination platform, by providing course content details to students. Apart from that, it is used to capture the content of the new version of the ITC's Master of Geo-Information program (MGEO). The GCH platform was used within the Astraios project [2], to power a catalog of almost 4000 courses on space-related topics from universities across Europe. By sharing ontology-based course metadata, connecting course information will become more

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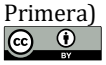

straightforward and facilitate evidence-based lifelong learning practices and support the management of curricula.

2. The platform

The GeoCourseHub platform [3] design is based on three main decisions.

Decision 1: To use the Semantic Web technology stack to represent and capture curriculum information. The choice of technology enables the effective realization of *FAIR* [4] principles. This decision enables the use of a range of semantic standards to capture the semantics of the data. As a result, a GCH ontology was designed and implemented [5] supporting the *reusability* of the data. *Interoperability* of the data is achieved using formal semantics captured in domain ontologies and a format-agnostic data model – Resource Description Framework [6].

Decision 2: To enrich the representation of intended learning outcomes (ILOs) with links to relevant domain concepts as well as with the Bloom level [7] indication. This approach allows for a more nuanced understanding of learning outcomes at various levels of abstraction and fosters an environment conducive to the semantic modelling of course content. It enables semantic search over the ILOs. This ensures not only the *findability* of the GCH resources but also facilitates the creation of individualized learning paths. The core enabling prerequisite is the availability of a database of concepts to be used for annotation of ILOs. GCH can use a Body of Knowledge, a network of concepts and relations between them. This can be an existing BoK (e.g. EO4GEO Body of Knowledge [8]) or a custom-created BoK.

Decision 3: To design a loosely coupled system that relies on the layer of programmable data interfaces. The platform consists of several independent software applications that all use GCH data via three types of connections: SPARQL, REST, and Elastic Search. *Browser* and *Register* are the main two interfaces where users can browse, create, and manage curriculum metadata. Both applications are built using the Linked Data Reactor framework [9]. ITC's LivingTextBook [10] is used for authoring BoKs. *Suggester* is a yet-to-be-developed component that assists in the individual learning path construction. The above-mentioned are internal to the platform. External applications that consume GCH data are Geoversity and Moodle Learning Management System. Flexible and technology-diverse data interfaces together with user interfaces add to the *accessibility* of the data.

3. Project Timeline

In its two years, with three employees (Stanislav Ronzhin, Rob Lemmens, and Roseidys Primera) the project managed to deliver several core components of the system including the GCH ontology, the data persistence layer, the data API layer, and the Browser. User testing was conducted on the Browser which provided access to 83 courses of the ITC's master courses.

The current focus (period 2024-2025) of the project is threefold. First is further enriching our platform with course content and domain concepts (both according to the GCH ontology). Second is the implementation of the user testing results. This will further

increase the usability of the platform. The third is to apply its use in different lifelong learning application scenarios and continue strengthening the integration with other external projects, in particular, the Shape Up project [11,12] and Geoversity.

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