

Intermediate Education Ontology

Project Code

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Intermediate Education Ontology

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Abstract:

Intermediate Education ontology represents the knowledge about Intermediate level education in Pakistan - Punjab province. Ontology will describe the semantics of data about Intermediate education. In Pakistan, students after matric are not very well aware of programs at the intermediate level. They get confused while selecting Intermediate programs. Ontology is aimed to provide students with appropriate knowledge representation of the intermediate programs and 2 years' time span information in one place.

Keywords: Intermediate, education, examination, boards, curriculum, programs, results.

1. Introduction:

We usually see *students confused while choosing their 2-year intermediate programs*. We are going to develop this ontology *to clear the students' queries about intermediate programs, before and after, they join college*. Intermediate education consists of 11th and 12th classes. Students mostly opt for 2 years programs for their intermediate education. Students in Punjab can take admission to different available programs. Some key programs that we will discuss in this scenario are FSC, ICS, I.com, and FA. College-level institutes (private and govt.) offer these programs for students. They require students to take admission to college at certain criteria. Students choose a program of their choice. They can choose among many programs. Punjab Boards offer FSC Pre Medical, FSC Pre Engineering, ICS Physics, ICS Economics, ICS Statistics, I.Com, FA General Sciences, and FA IT. Students get registered in BISE boards. After choosing any program, students take 1st year and then 2nd year's examination after a whole year's preparations. They also take practicals of scientific subjects. Boards are regularized by Higher Education Department Punjab. They provide admission, examination schedules, fees, and information related to scholarships and facilities. The Board of Intermediate and Secondary education (BISE) works under the province. This institute is responsible for adding subjects to the curriculum, conducting examinations, and announcing results for the intermediate students. The result is announced for each 1st and 2nd-year class. We will cover all the above-mentioned aspects in our ontology. (Admission, Examination, Results, Academics, Non-academics, and relevant Institutes)

Several ontologies exist related to the education domain but there is no comprehensive work previously done regarding intermediate education in ontology and specifically in Pakistan Education system. *The previous ontologies were engineered specifically for institutes and other countries' education systems; they either do not reassemble the education system in Pakistan and its provinces at Primary, Intermediate, and Higher levels; or are mostly covering a single aspect of the educational domain.* I.e. University, college, and courses separately, *from the all aspects that we will cover.* The purpose of this paper is to describe the main aspects of ontology. This ontology emphasizes these aspects: intermediate program selection, academics, and facilities i.e. scholarships, examination, and results (2-year academic duration).

We will gather non-ontological resources from the Punjab Curriculum and Text Board, Higher Education Department Punjab, and the Board of Intermediate and Secondary Education websites. (If required, from colleges also). We require PCs for installing the software tools. We require MS office, Graphics Editor, Protégé, Additional Software and websites: Github, Web-vowel, and WIDOCO. Different IDEs are available for ontology development; we have searched NeOn Toolkit and Protégé.

- *NeOn toolkit:* Provides explicit support for developing ontologies following the proposed methodology.

- *Protégé*: It has a graphical user interface; easy to use, and has owl based user interface that we will use in ontology engineering.

We will use Protégé for ontology development. Other helpful tools that we will use in our ontology include:

- *Owl*: Owl language will be used to implement the ontology.
- *Web-vowel*: Web vowel will be used for interactive visualization of ontology.
- *GitHub*: Online platform for publishing the ontology.
- *WIDOCO*: WIDOCO will be used for ontology documentation.
- *SPARQL*: SPARQL language will be applied to query the ontology.

2. Related Work

This section of the document describes the searched ontologies that we found similar to our project as these ontologies were related to education. They are quite useful in understanding the process that we can adopt to engineer our Intermediate education ontology. Here are the ontologies that have been found after the search:

Large amounts of unstructured data based on academic programs cannot be efficiently organized by conventional database systems. Therefore, it might be difficult for potential students to gather the knowledge required to make wise judgments, taking into account elements like individual preferences, accessible possibilities, and the employment market. This study suggests a comprehensive framework that makes use of the most recent semantic ontology-based technologies. In unambiguous queries, the proposed system can effectively extract user-specific constraints, which can then be used to retrieve more precise data [1]. Ontologies may model several elements of knowledge management for online learning in higher education. In this study, ontologies can represent current knowledge from a domain. In the context of knowledge management, universities provide an updated view of higher education in which students are the consumers of knowledge. The ontological framework described in this research is used to model and combine knowledge management processes and technology architecture for knowledge management in online learning [2]. The ontology is the foundation of the semantic web. This paper shows, how to build an ontology in the field of education. A course ontology is developed that incorporates all the information about the numerous courses the institution offers. Depending on their current qualifications, students can use the course ontology as a reference when choosing a future course. The Protégé 4.0 alpha tool is used to develop the course ontology [3]. The paper concentrates on using Protégé to build a university ontology. The Rajiv Gandhi Technical University in Bhopal, India, has been used as an example for the development of an ontology. Many different aspects, including the superclass and subclass hierarchy, the creation of subclass instances for class illustrations, the visualization of the query retrieval process, and the graph view, have all been shown. The Paper describes all the aspects of Rajiv Gandhi University like examinations, departments, and programs as ontological terms [4].

The Bologna declaration seeks to address the issues and difficulties faced in European higher education. One of its key objectives is the creation of a uniform system of transparent and comparable degrees that will guarantee the acceptance of people's knowledge and credentials throughout the European Union. This study will explore an ontology-based paradigm that encourages the development of trustworthy knowledge assessment and the construction of transparent curriculum material (Educational Ontology) [5]. This paper focuses on several ontological relationships among various concepts in university. The study is divided into four sections: the introduction, the explanation of our work, the conclusion, and suggestions for further research. The University of Palestine, a private Palestinian higher education institution, located in Al-Zahra' (south of Gaza City) [11, 12], is the case study in this paper. It was founded in 2005. Every concept is mostly centered on the student, teacher, and course [6].

3. Design Methodology

Design Methodology is the sequence of steps we take to engineer/re-engineer our ontology. Different methodologies are available for ontology engineering. Here are three methodologies that we have searched:

1. Sensus
2. Uschold and King
3. NeOn

1. Sensus: This technique creates domain-specific ontologies out of big ontologies. It was created by Information Sciences Institute Natural Language Group. The top-down approach is used in this practice. Below are the steps in the process:

1. The *seed*, or important phrases, are identified.
2. Using Ontosarus to manually *link* the phrases
3. All ideas are present, from the root to the seed phrase.
4. Including a *new relatable term* that isn't already there.
5. Including *sub-trees* in the finished ontology [7].

2. Uschold and King: Uschold and King proposed the first ontology development technique in 1995. The experience of creating an ontology for enterprise modeling procedures served as the foundation for this methodology. There are four steps to it:

Step 1: Selecting the purpose, uses, domain and intended users is the first step.

Step 2: Engineering ontology is the second step.

Step 3: Ontology Evaluation

Step 4: Ontology documentation [7]

3. NeOn Methodology: The NeOn technique provides several pathways for creating ontologies; it is flexible rather than outlining a predetermined course of action. It has no application dependencies. It provides definitions for *nine scenarios*, a *glossary of terms* related to processes and activities, two ontology *life cycle models* (the waterfall and iterative-incremental models), as well as a list of methodological guidelines for various processes and activities. [8]

We selected NeOn Methodology for our project.

4. Development:

We selected NeOn Methodology to develop Intermediate Education Ontology. We have examined both NeOn life cycles (Waterfall and Iterative) and selected six-phase Iterative Incremental life cycle Model.

We will use the following phases:

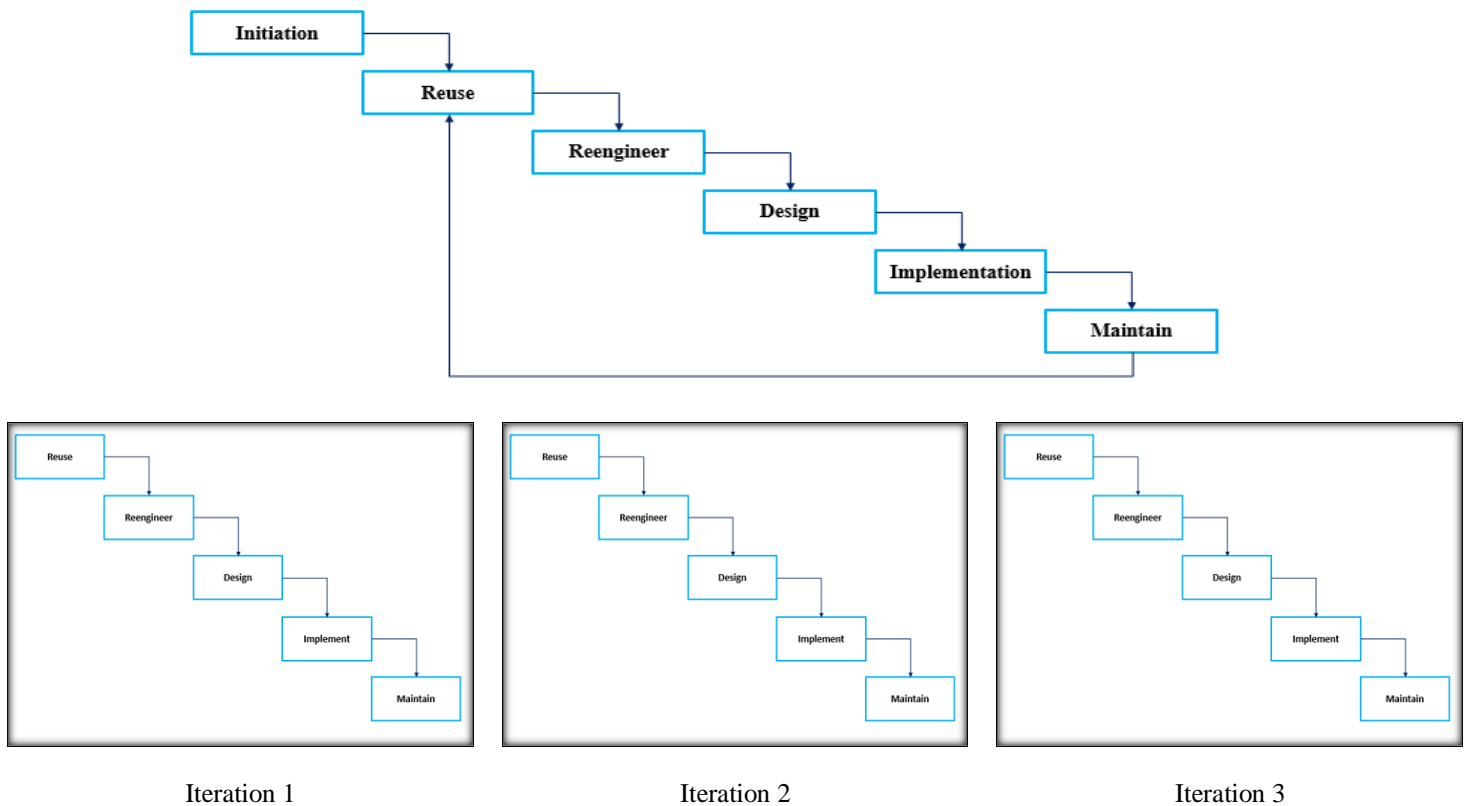


Fig1. Neon Iterative Incremental Life Cycle Model model phases and iterations

4.1 Initiation:

We developed an ontology requirement specification document for intermediate education that covers the following topics: Purpose, scope, implementation language, and functional and non-functional needs. Competency Question Groups are used to categorize Functional Requirements. The Competency Question Groups are Admission, Facilities & Non-Academic Aspects, Boards, Institutional Requirements, Curriculum, Examination, and Results.

4.2 Reuse:

The reuse section includes ontological and non-ontological resources that we searched for and reused in this ontology.

Admission: No resources were reused in this section.

Facilities & Non-Academic Aspects: No resources were reused.

Boards: Non-ontological resources taken from Punjab Higher Education Department Website [9]. No ontological resources were reused.

Institutional Requirements: No non-ontological or ontological resources reused.

Curriculum (Academics): Non-ontological resources taken from Punjab Curriculum and Textbook Board Website [10]. No ontological resources were reused.

Examination: Non-ontological resources taken from Boards of Intermediate and Secondary Education Websites [11]. No ontological resources were reused.

Result: Non-ontological resources taken from Boards of Intermediate and Secondary Education Websites [11]. No ontological resources or Design patterns were reused.

4.3 Re-engineering:

In re-engineering phase, we converted the non-ontological resources that we searched in reuse phase; into conceptual models. This section had some paper work to draw the relations and identify the entities that could be used as classes, object properties, instances and the data properties from searched non-ontological resources.

4.4 Design:

We did not reuse any ontological resources. Ontology was engineered from scratch with help of available non-ontological resources that we converted into ontological ones. We created following modules in design phase:

- | | |
|----------------------|----------------------|
| a. Class hierarchy | d. Instance creation |
| b. Object properties | e. Visualization |
| c. Data properties | |

Conceptual models created during reengineering phases were used as input for the design phase. This phase also included some paper work to draw relationships among classes.

4.5 Implementation:

Ontology was implemented in OWL Language using Protégé, followed by evaluation.

4.6 Maintenance:

Maintenance phases mainly deals with error detection. If some error is detected, we start reworking from the Reuse phase.

5. Ontology Modules:

The details of the ontology modules that we developed during the design phase are covered in this section.

Summary of Ontology Requirements Specification Document

1. Purpose

The purpose of the Intermediate Education ontology is to provide students with knowledge representation of their inter programs.

2. Scope

Intermediate Education ontology is specific to the Intermediate level (11th and 12th classes). The ontology includes knowledge related to Intermediate courses only. It does not include knowledge about other levels' (Primary, Secondary, A/O Levels, and Higher). It limits to Intermediate Education in the Punjab province of Pakistan (students under BISE-Punjab).

3. Implementation Language

Owl language will be used to implement the ontology.

4. Intended Users:

Sr. No.	User
<u>User 1:</u>	Students
<u>User 2:</u>	Teachers
<u>User 3:</u>	Colleges
<u>User 4:</u>	Punjab Text and Curriculum Board
<u>User 5:</u>	Punjab Higher Education Department
<u>User 6:</u>	Board of Intermediate and Secondary Education

5. Intended Uses:

Sr. No.	Use
<u>Use 1:</u>	To get information about admissions.
<u>User 2:</u>	To guide the students about program selection.
<u>User 3:</u>	To guide students about board registration.
<u>User 4:</u>	To guide students in Academics.
<u>User 5:</u>	To guide students about scholarships.
<u>User 6:</u>	To guide students about the result announcement.

6. Ontology Requirements

6.1 Non-Functional Requirements

- **Performance:** Ontology should meet all the aspects of Intermediate Education (as per the defined scope).
- **Safety:** We will keep an updated copy on Github that will serve as a backup in case of any loss.
- **Security:** As we will publish ontology on Github with a license, copyrights will be defined in the license.

6.2 Functional Requirements (Competency Question Groups)

G1: Admission

ID	Question
G1-A:	What are the attributes in the admission form?
G1-B:	Which institutes offer the intended program?
G1-C:	What is the duration of Inter program?
G1-D:	Which programs are available for Inter students?

G2: Facilities & Non-Academic Aspects

ID	Question
G2-A:	Which facilities are given to students in college?
G2-B:	Which scholarships are available?
G2-C:	Which sources will be used to acquire scholarships?
G2-D:	What is the summer and winter vacations' duration?
G2-E:	Which co-curricular functions take place at colleges?

G3: Boards

ID	Question
G3-A:	Which boards in Punjab are offering the Inter Programs?
G3-B:	Which attributes are there in the board registration form??
G3-C:	How many students are registered in each board?

G4: Institutional Requirements

ID	Question
G4-A:	When are Intermediate programs' classes starting?
G4-B:	When Intermediate programs' classes End?

G5: Curriculum (Academic)

ID	Question
G5-A:	What are the contents of the Syllabus for 1 st and 2 nd years?
G5-B:	Who is responsible for approving the subjects for intermediate?
G5-C:	Who is responsible for preparing and approving the syllabus for intermediate?
G5-D:	Which subjects are there in each inter-program?
G5-E:	Which subjects are elective?
G5-F:	Which subjects are compulsory?
G5-G:	What are language choices for students?

G6: Examination

ID	Question
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G6-A:	Who is responsible to conduct the examinations in Punjab?
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G6-B:	Who is responsible for deciding the subjects for intermediate?
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G6-C:	Who issues roll no slip?
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G6-D:	What attributes does roll number slip include?
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G6-E:	Which subjects' practical is taken?
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G7: Result

ID	Question
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G7-A:	Who announces the result?
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G7-B:	What attributes does the result sheet include?
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G7-C:	What are the passing criteria for students of intermediate?
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G7-D:	What are the fail criteria for students of intermediate?
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7. Pre Glossary of Terms

Education, intermediate, program, examination, practical, scholarships, college, admission, vacations, subjects, compulsory, elective, roll number slip, pass, fail, result, board, BISE, PTCB, PEB, syllabus, registration, medium.

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