



TIPHYS- Social Network based doctoral Education on Industry 4.0

Antonio Maffei

HEIn4.0



Co-funded by the
Erasmus+ Programme
of the European Union





Swedish Council for
Higher Education



Co-funded by the
Erasmus+ Programme
of the European Union

XPRES

Initiative for excellence in production research



Needs to be answered

- PhD students are a small group of individuals, everyone with a personal and specific learning history
- The training offered by each University cannot satisfy the specific needs of a small population of students.
- PhD students see a dichotomy between their specialized study goal and the generalized training offered by their University.
- It is difficult that a group of PhD students from the same University get engaged in shared learning activities and be able to constitute a learning team.



Approaches to PhD education

It is a mess!

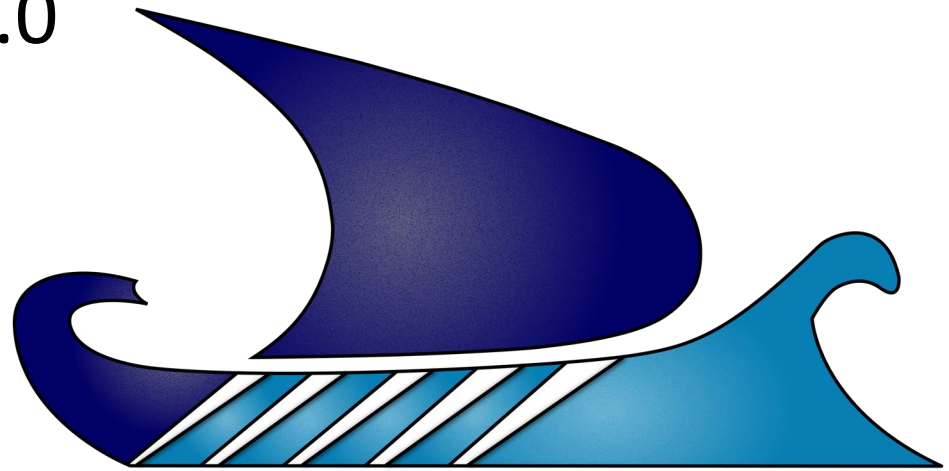
Some example:

- Requirement are often based on the discipline
- Some (big) countries don't have formally established PhD course... specifications and means for learning during PhD are left to the student/supervisor
- Some countries rely on trainee program in industry
- Some Universities have their own all-in one course/program that all the PhD are following
- Sweden is a pioneer in Tiphys like cooperation thanks to the Production 2030 education network (and before that the pro-Viking)



Why “Tiphys” as acronym?

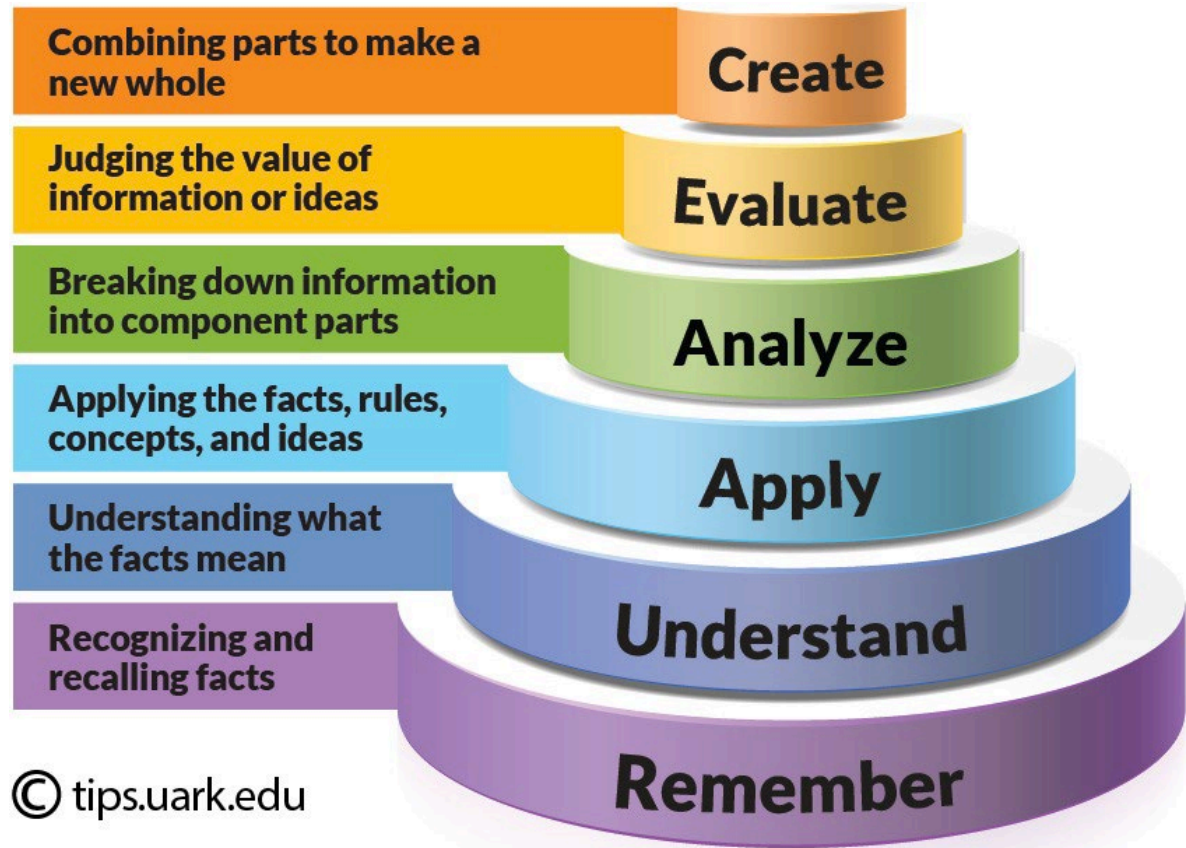
Social Network based doctoral Education
on Industry 4.0



TIPHYS
Industry 4.0

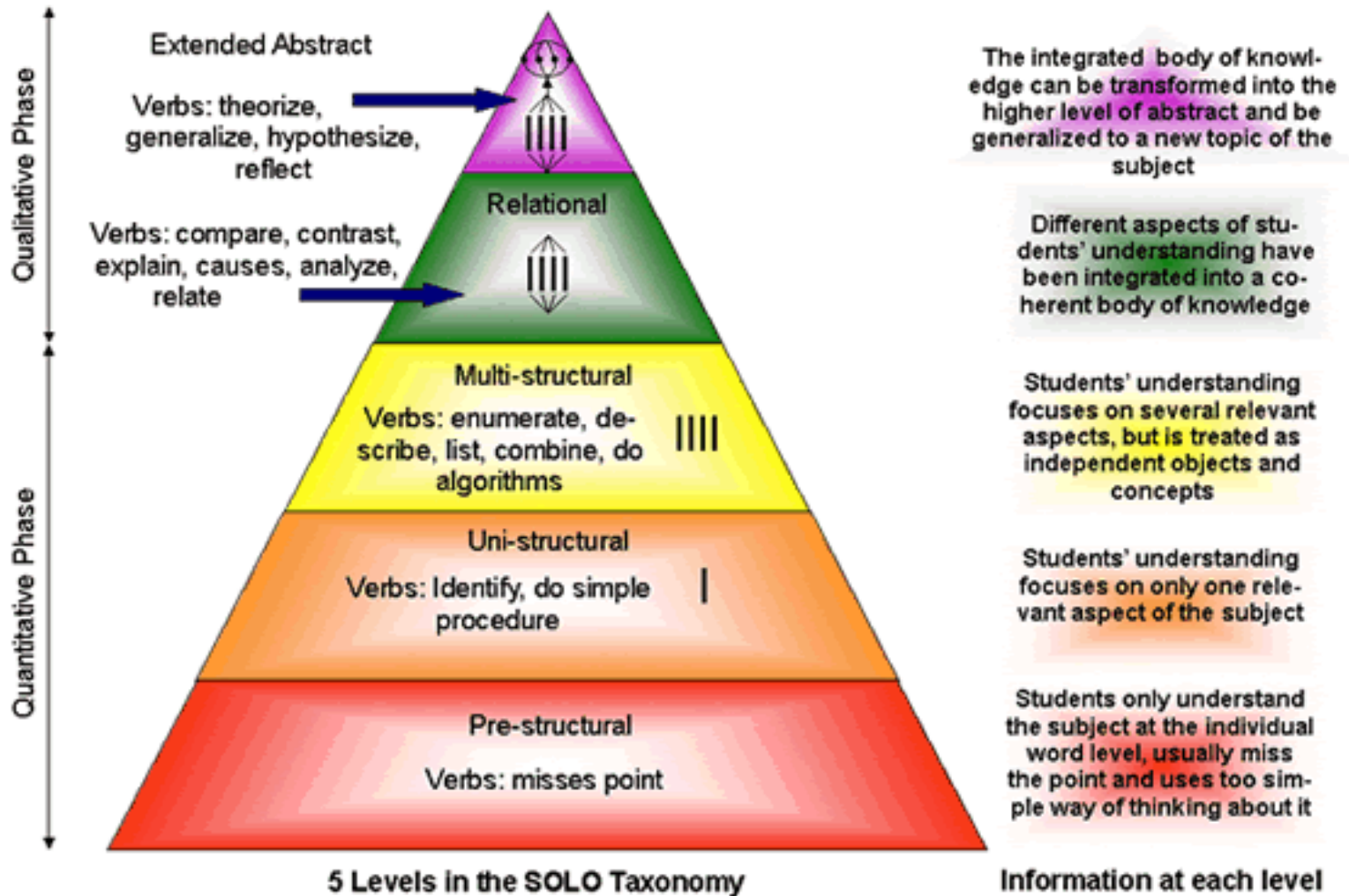
Pedagogical characterization of PhD course

Bloom Taxonomy



Pedagogical characterization of PhD course

SOLO Taxonomy





So what is an ideal PhD course?

Bloom taxonomy:

- Evaluate and Create level

Solo Taxonomy

- Extended abstract knowledge

Good PhD courses include two component:

- General:
 - solid scientific foundation
 - capability of using general research related tools (EndNote, progr. Language, lab view, matlab etc..)
- Specific:
 - Good balance of very specific and often leading edge* theory and practice
 - Clearly established pattern to learning in a flexible context (time is money)
 - Creation of a Community of Learning (Col) for higher objectives**

*Based on research papers, project deliverables rather than published books or established practices/standards

** no time to detail there but we can discuss it separately



Specific Objectives

- Increase the cooperation among educational institutions in EU to increase the quality of PhD courses connected with Industry 4.0
- Increase the synergic use of up-to-date technologies, such as virtual reality, in an integrated way, with a team work approach and personal development
- Improve the effectiveness of teaching and learning by the use of Blooms Taxonomy
- Increase the opportunity for distance learning
- Upgrade and innovate existing didactic tools



How will we achieve them...

- Build an Open Networked Platform for the learning of Industry 4.0, dedicated to PhD students
- The project will create a set of models in order to standardize the learning
- The models will be structured in a modular approach
- The project will examine the necessary changes in existing platforms
- The students will be able to co-create their learning track and the learning contents
- Dynamic students teams will be created for every specific learning requirement



Useful methods / technologies

- Social Network-Based Education
- Constructive Alignment

- Massive Open Online Courses
- Virtual Reality
- Wiki: a website on which users collaboratively modify content and structure directly from the web browser (*From Wikipedia, the free encyclopedia*)



Tiphys main Outputs

1. Ontological framework is based on constructive alignment for the representation and composition of educational units. The ontological framework model will allow definition of small "constructively aligned" course modules including a single Intended Learning Outcome (ILO) and its related Teaching and Learning Activities (TLA) and Assessment Task (AT).
2. The open access platform will consist of specific modules to support learning activities, including simulation modules, virtual reality modules, decision support modules and user-interfaces. The modules will be "docked" on the learning platform with the ontology-based models as integrating elements.
3. Collaborative creation of learning material by teams of students through a participative learning approach following the precepts of Education 3.0.



Tiphys other Outputs

4. Virtual model of a reference Industry 4.0 factory: a variety of training material and wiki to be used for dissemination activities of TIPHYS project.
5. Continuous improvement and increase of platform content based on user interaction and on smart exploitation of user experience.



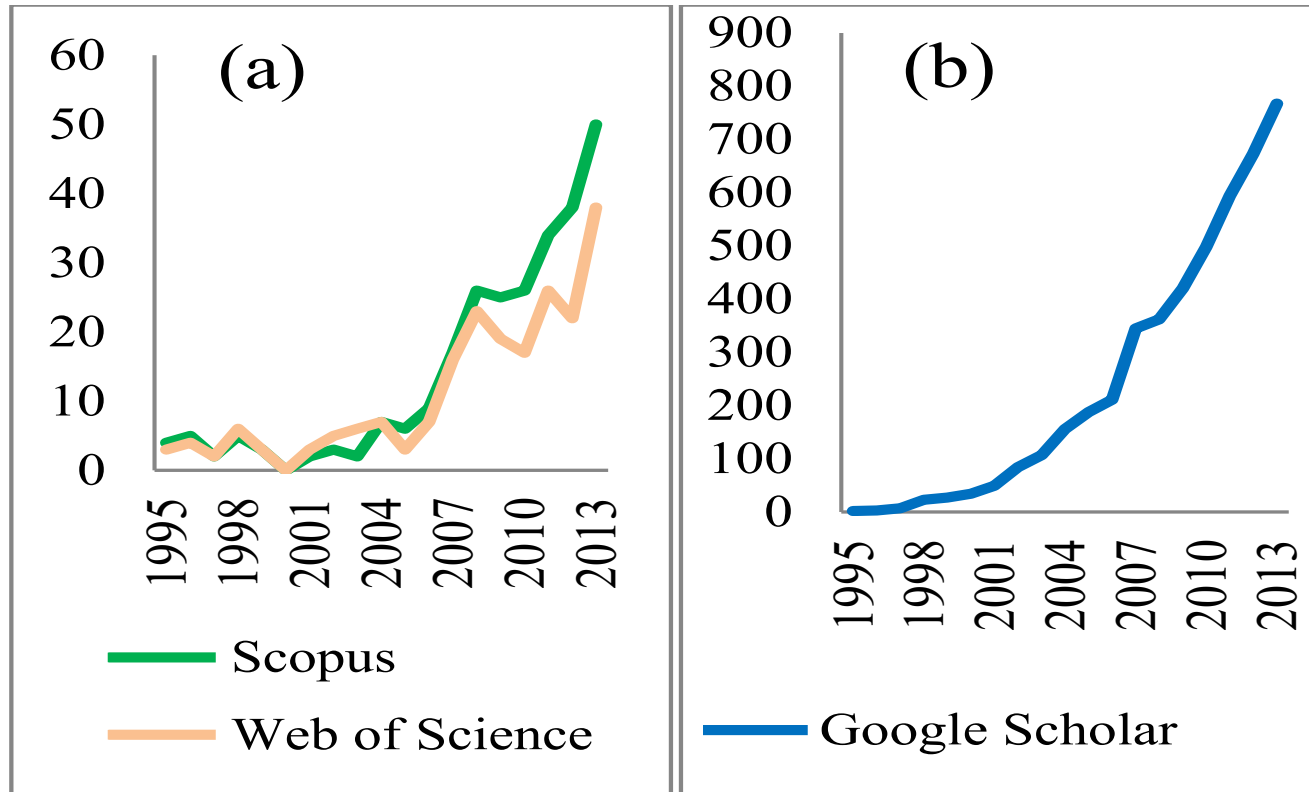
Output 1 Constructive Alignment Learning Ontology (CONALI)- KTH, Sweden

- Atomization of the educational units: enhance possibility to compose original curricula
- Reduction of complexity in communication and sharing of resources
- Supports computer friendly analysis and synthesis
- Approach followed by the leading academic editors

In addition to that:

- Harmonizes the language
- Facilitates the shift from transmissive pedagogy to constructive pedagogy, i.e. Constructive Alignment (CA)

Constructive alignment in literature



(a) Annual number of paper with CA as main topic in Scopus and Web of Science. (b) Annual number of documents featuring CA in Google Scholar



Constructive alignment at KTH

- LH201V Learning and Teaching. Available:
<http://www.kth.se/student/kurser/kurs/LH201V?l=en>
- LH202V Knowledge Building in Teachers Practice.
Available:
<http://www.kth.se/student/kurser/kurs/LH203V?l=en>
- LH216V Develop the Learning by Using Grading Criteria.
Available:
<http://www.kth.se/student/kurser/kurs/LH216V?l=en>
- ...



Problem with Constructive alignment...

Problematic areas connected with CA

1. Scarcity of Resource (Biggs)

2. Resistance to Change (Biggs)

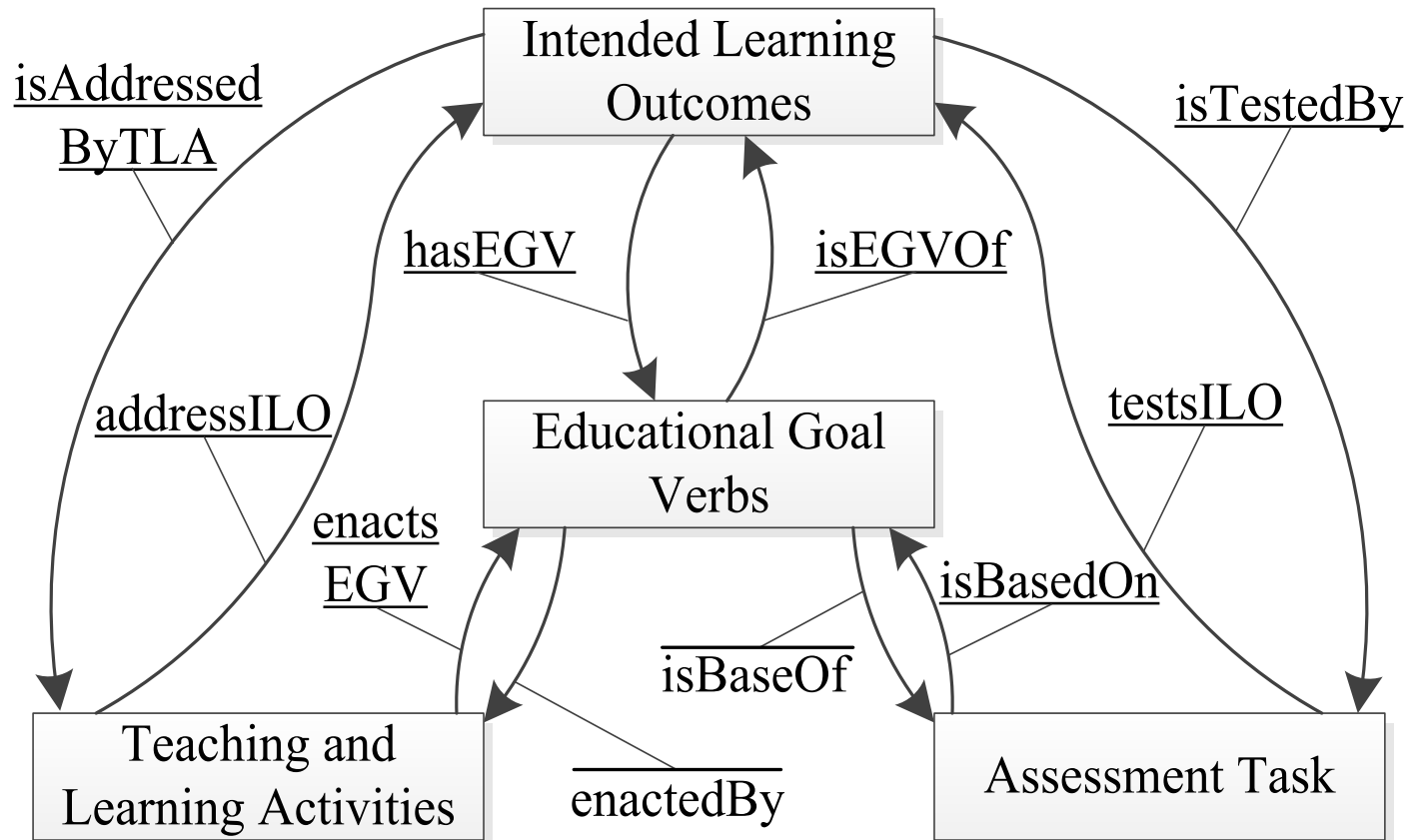
3. High interest and consequent risk for uncontrolled and diverging growth (Authors)

4. Assessing CA (Authors plus literature)

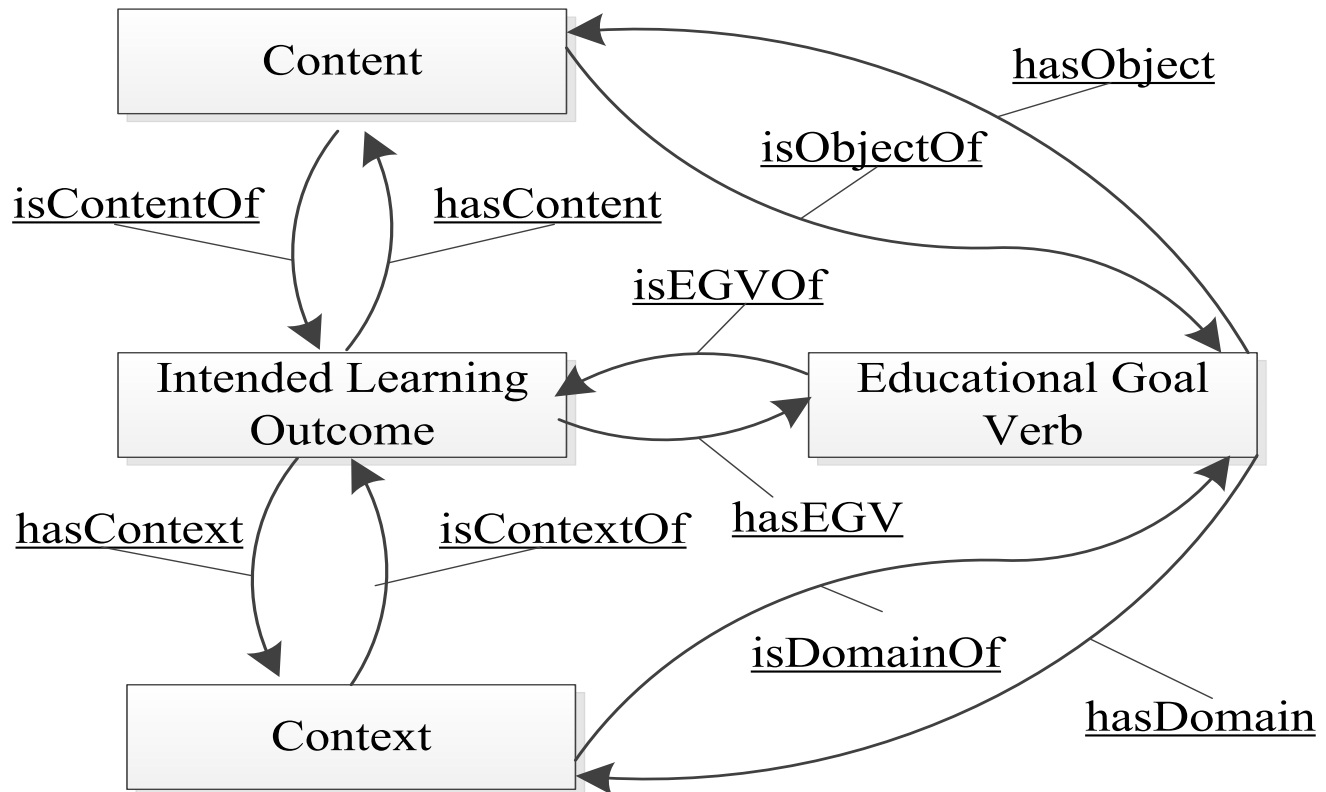
...and solution offered by ontological approach

Problematic areas connected with CA	Benefit of producing an ontology
1. Scarcity of Resource (Biggs)	<ul style="list-style-type: none">- To enable reuse of domain knowledge- To analyze domain knowledge
2. Resistance to Change (Biggs)	<ul style="list-style-type: none">- To make domain assumptions explicit- To separate domain knowledge from the operational knowledge
3. High interest and consequent risk for uncontrolled and diverging growth (Authors)	<ul style="list-style-type: none">- To share common understanding of the structure of information among people or software agents
4. Assessing CA (Authors plus literature)	<ul style="list-style-type: none">- Through analysis of the body of knowledge produced and definition of specific KPI

Main assumption behind CA



Intended Learning Outcomes





Instantiation of the ontology: EGV

Remembering Verbs

- ◆ Define
- ◆ Describe
- ◆ Draw
- ◆ Find
- ◆ Identify
- ◆ Imitate
- ◆ Label
- ◆ List
- ◆ Match
- ◆ Memorize
- ◆ Name
- ◆ Narrate
- ◆ Quote
- ◆ Recall
- ◆ Recite
- ◆ Recognize
- ◆ Tell
- ◆ Write

Understanding Verbs

- ◆ Classify
- ◆ Compare
- ◆ Conclude
- ◆ Count
- ◆ Demonstrate
- ◆ Discuss
- ◆ Exemplify
- ◆ Explain
- ◆ Identify
- ◆ Illustrate
- ◆ Interpret
- ◆ Narrate
- ◆ Order
- ◆ Paraphrase
- ◆ Predict
- ◆ Recognize
- ◆ Report

....

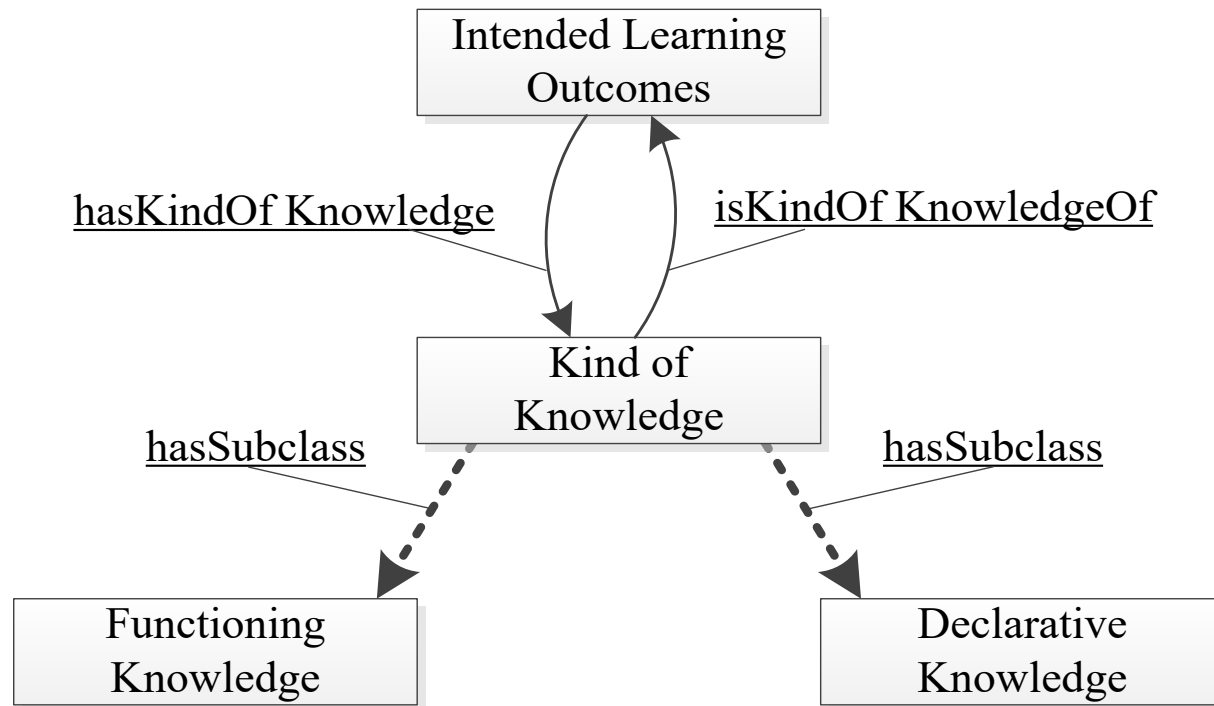
Creating Verbs

- ◆ Compose
- ◆ Construct
- ◆ Create
- ◆ Design
- ◆ Develop
- ◆ Extrapolate
- ◆ Generalize
- ◆ Generate
- ◆ Hypothesize
- ◆ Improve
- ◆ Integrate
- ◆ Invent
- ◆ Make
- ◆ MakeAnOriginalCase
- ◆ Originate
- ◆ Perform
- ◆ Plan
- ◆ Produce
- ◆ ProveFromFirstPrinciples

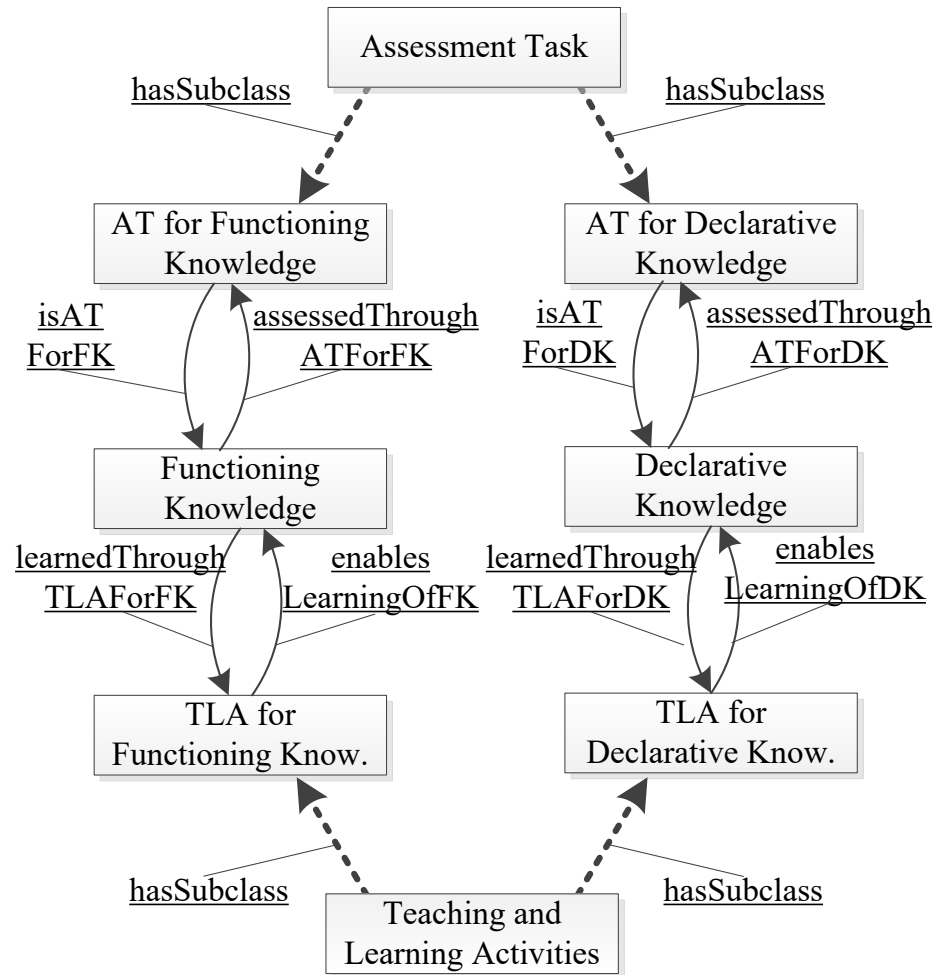
Instantiation on a course

ILO	EDV	TLA	AT	KoKnow
01	Describe	Lecture	Multiple Choice Short Answer	Declarative (D)
02	Choose	Lecture	Multiple Choice	D
03	Name	Lecture	Multiple Choice	D
04	Plan	Learning Cell	Group Project	Functional (F)
		Peer Teaching	Student Presentation	
05	Use	Tutorial Case Based Learning	Group Assessment	F
06	Produce	Interactive Work in Class	Short Practical Exercise	F
07	Describe	Lecture	Multiple Choice	D
08	Understand	Learning Cell	Group Project	F
		Peer Teaching	Student Presentation	

Kind of Knowledge



Kind of Knowledge alignment





Operative plan Output 1

- Further formalization of the CONALI ontology
- Population with real instances from partner universities:
 - Business Driven Production development
 - Discrete Event Simulation
 - Numerical methods
 - Virtual and Augmented Reality
 - ... List to be completed

When completed in 2 years you will be hopefully able to use it!



Output 2 Development of the MOOC content- University of Naples, Italy

- The definition ontology developed in O1 will be used as a support for the reorganizing and loading of the didactic material on the MOOC Platform.
- The output will be the identification and development of specific modules to support learning activities, including simulation modules, virtual reality modules, decision support modules and user-interfaces.
- The modules will be “docked” on the learning platform with the ontology-based models as integrating elements serving as “one interface”.



Output 3 Co-creation of learning material- University of Minho, Portugal

Effective and efficient co-creation of learning materials implies:

- Social network- or large complex network-based organization across multiple institutions (nationally and internationally) and multiple disciplines (curricula units, or subjects, or courses), that will involve both the students and teachers as co-creators of learning materials;
- Procedures/protocols for sharing elements of teaching materials, for access to shared learning materials, and for co-work;
- ICT platform that (1) enables collaborative work, (2) is cloud- and internet-based, (3) integrates large percentage, if not 100%, of freeware and open source applications and environments, (4) has the capability of embedding required applications for both co-creation and use of learning materials



Output 4 Virtual model of factory processes- Tech. Univ. of Epirus, Greece

- The consortium will collaborate and create a prototype version for the TIPHYS VR platform. The simplicity and modularity of the proposed platform must permit the use of a formal language to undergo updates and extra feature description. TEIEP will lead the communication and the creation of the VR prototype.
- Each participant will convert the scenarios described in previous task to the appropriate formal format. TEIEP is responsible to support all the consortium on the creation and enhance the models to achieve the best results.



Output 5 Development of final tool and additional content co-creation- TU Kosice, Slovakia

The courses are available and now what?

EUROPASS Certification of the system based on:

- a description (a model) of key elements for skills assessment and accreditation of candidates
- a list of ICT and developed tools, which will support the different elements of skill assessment and courses available for upgrading skills
- an online simulator to test and assess candidates skills
- a list of results and experiences collected in the project
- recommendations for further improvements.