Proposal for A Multi-country Curriculum Mapping Effort

Presentation of IS Prototype and Mapping Technique

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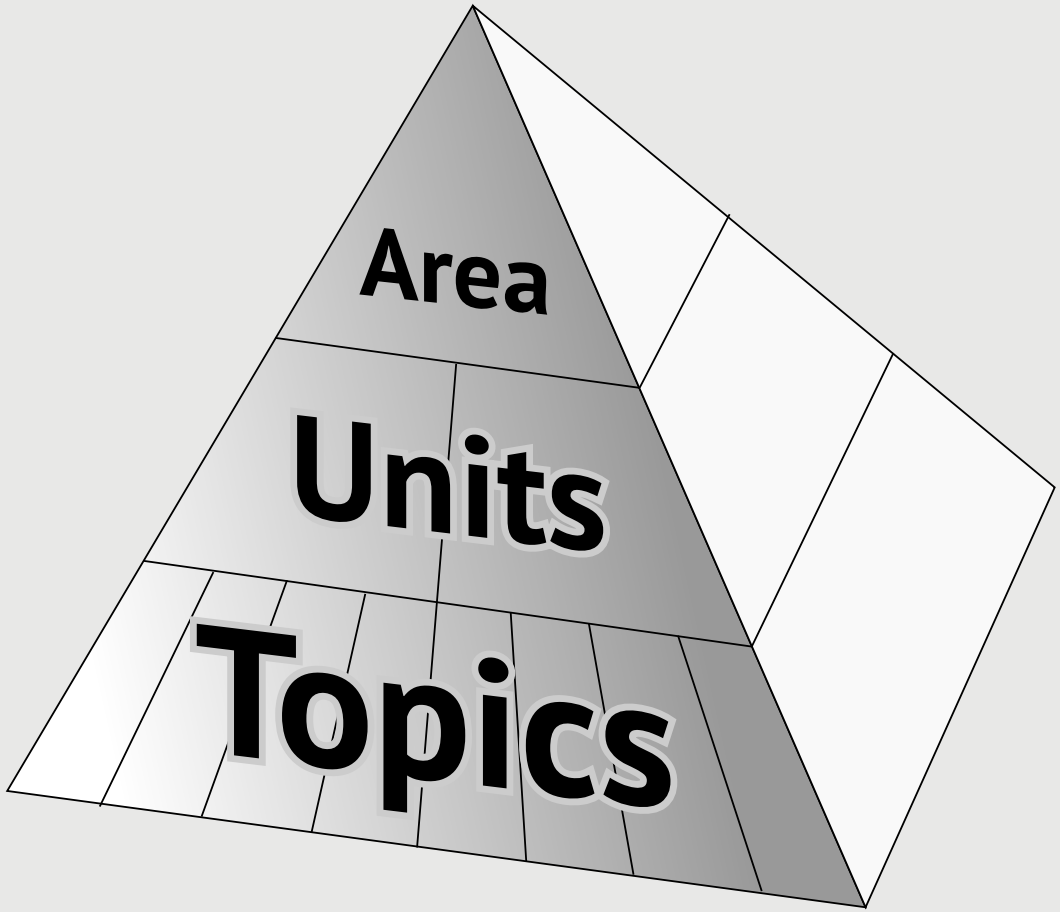
Presentation Overview

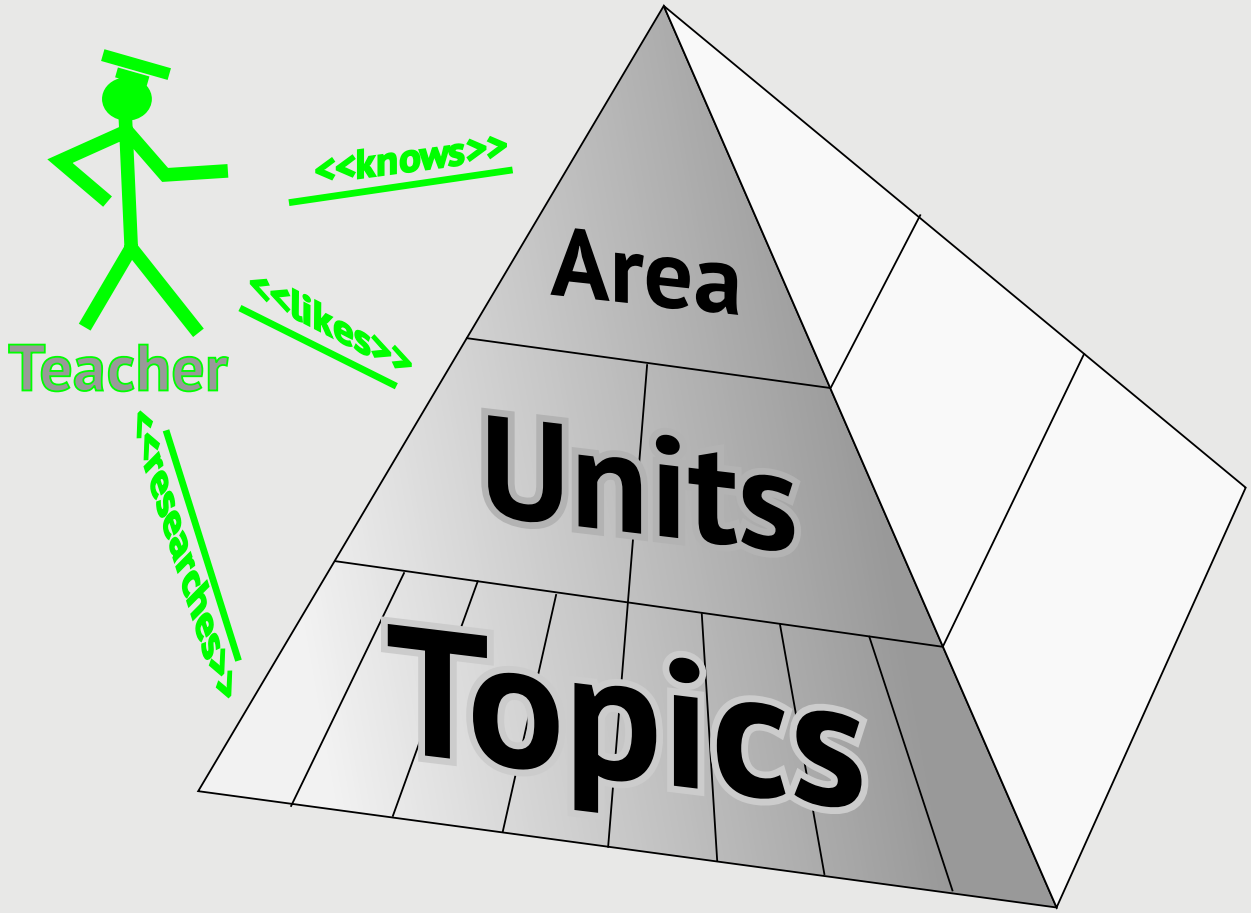
- Title
- The Vision: Context, Problem, Position
- System Design
- System Implementation
- Experience and Discussion
- Questions and Comments?

Context: Start with the Body of Knowledge

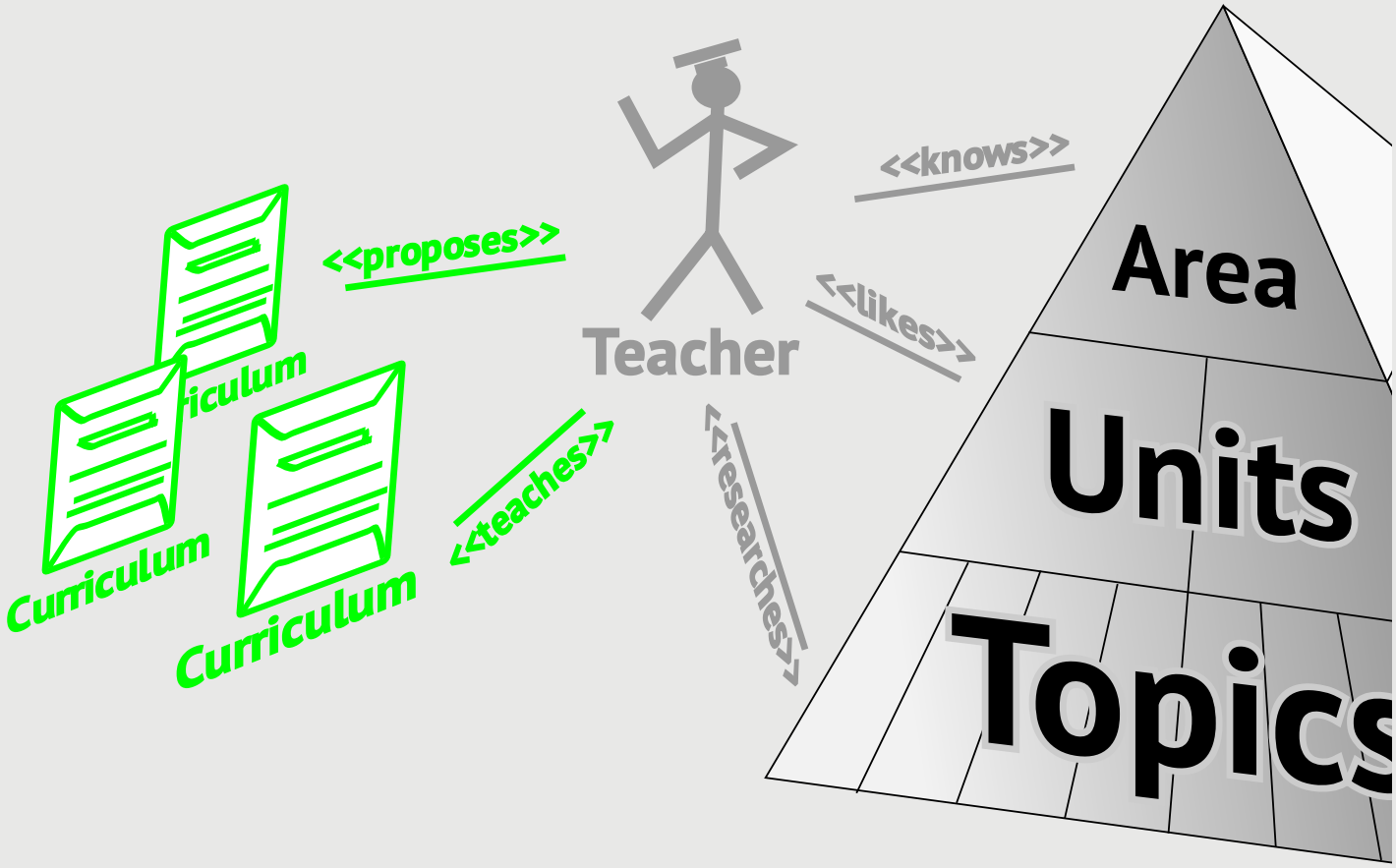
Contents



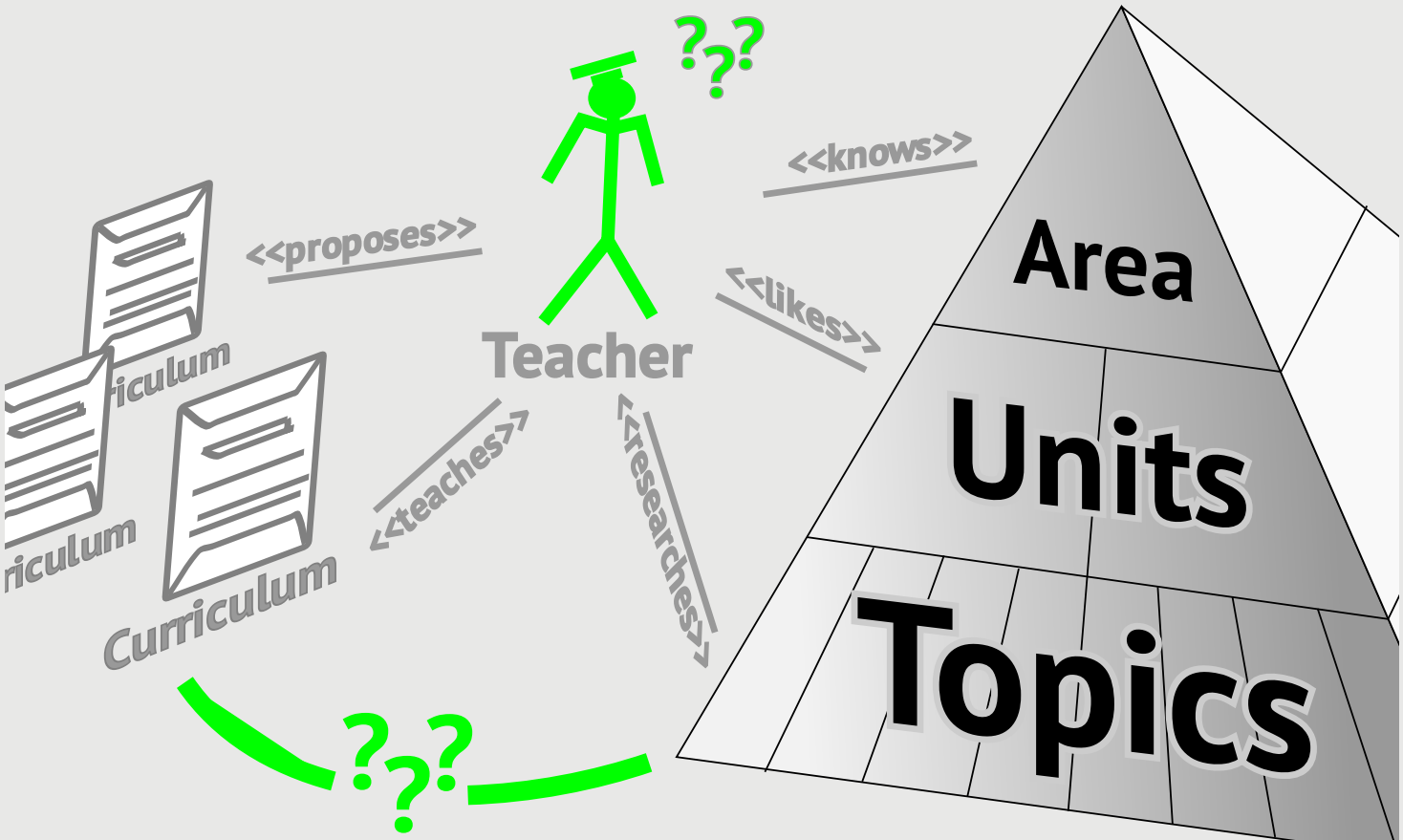
Teacher - BoK relationships



Teacher - Curruculum relationships



Curriculum - BoK relationships?



Implicit versus Explicit Knowledge

Chomsky (1965): *"Obviously, every speaker of a language has mastered and internalized a generative grammar that expresses his knowledge of his language. This is not to say that he is aware of the rules of the grammar or even that he can become aware of them."*

Quine (1972): *"Behavior is not guided by the rule unless the behaver knows the rule and can state it"*

The teacher does not truly ...
"know" (in the sense of the BoK)
"what" (in the sense of the structure of the subject of knowledge and relation to the teaching content)
is teaching (in the sense of ability to follow the structure)
... **unless able to put it into an explicit statement on relationship.**

System Design

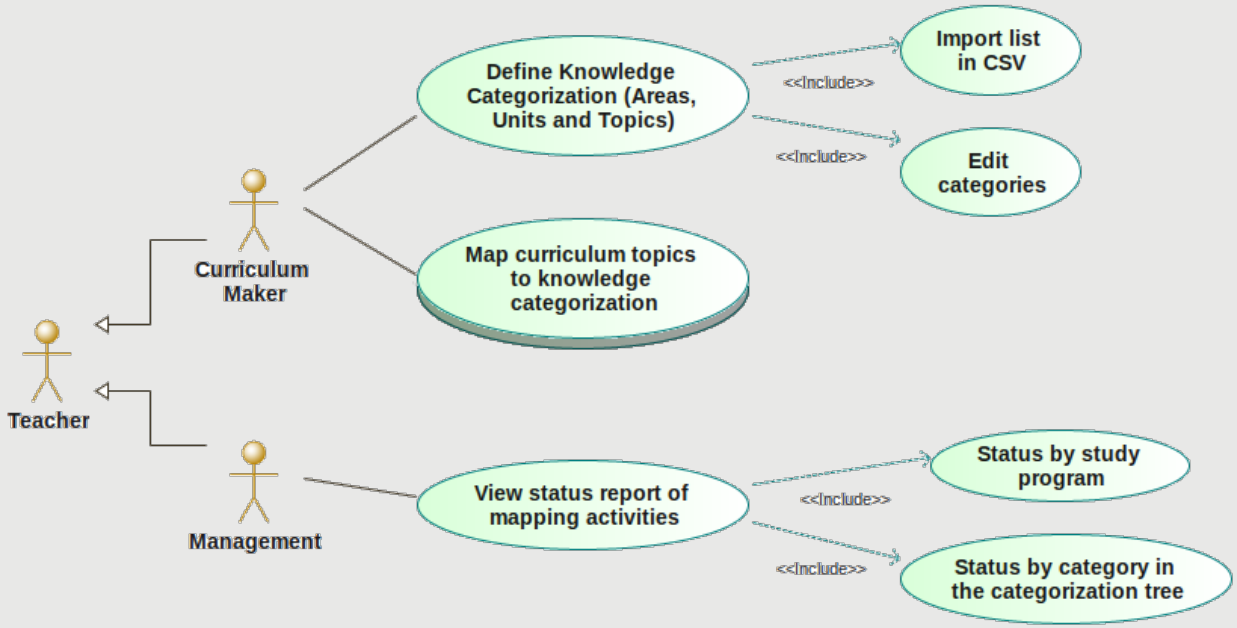
Contents

Problem: Turning implicit into explicit

Solution: Curriculum Mapping is proposed

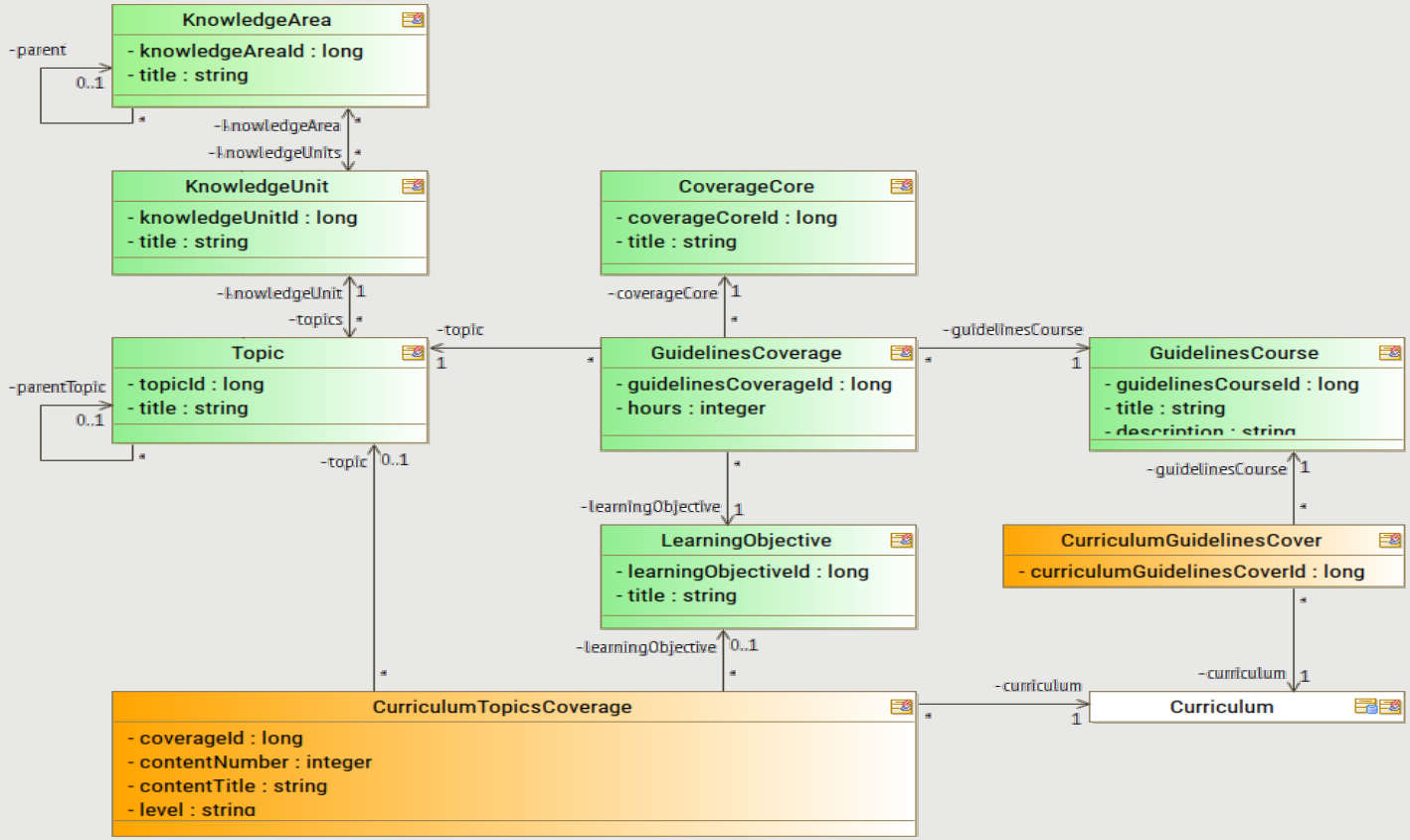
Positioning: For teachers, management, students

Overview level use-case model:

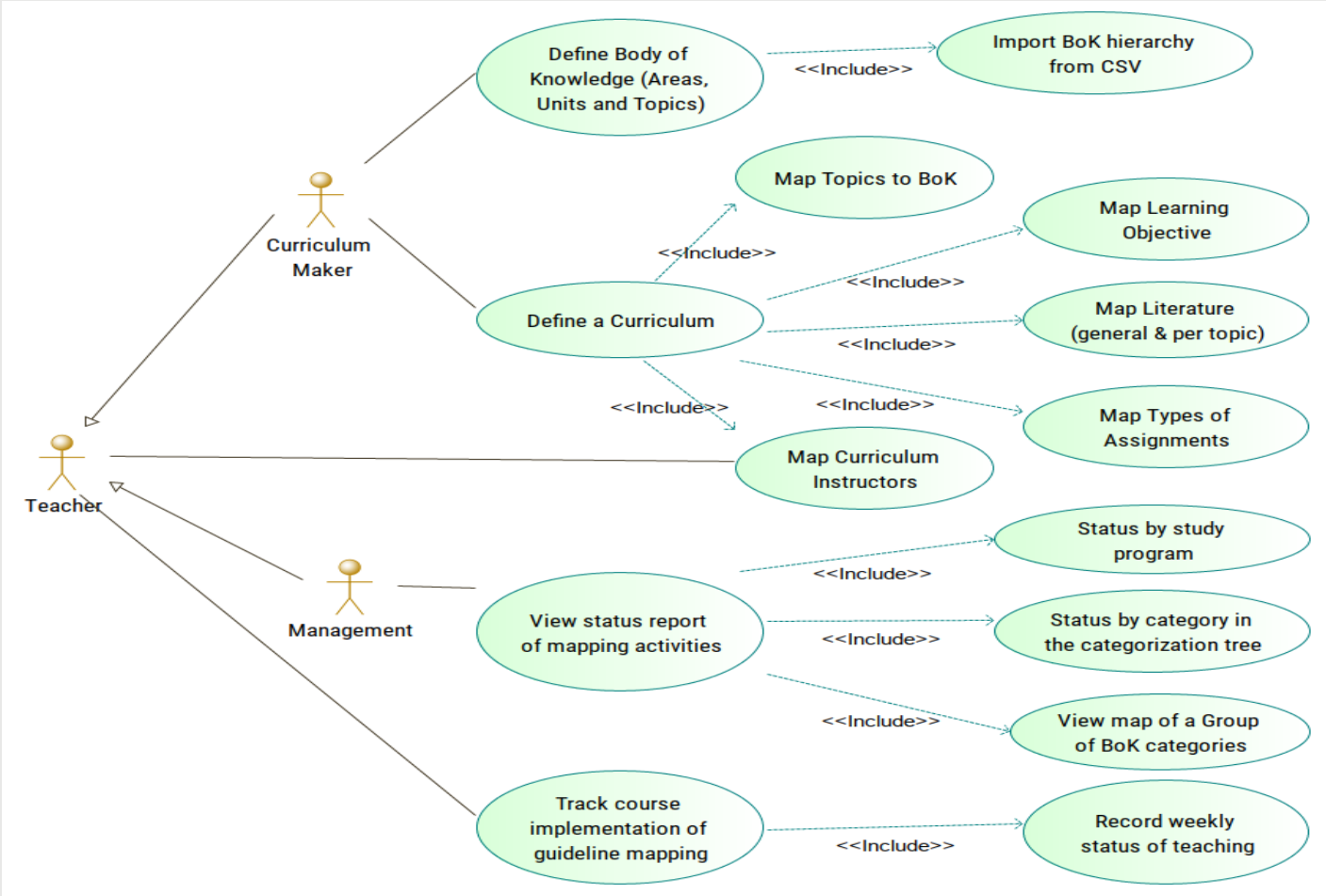


Study program and curriculum structure

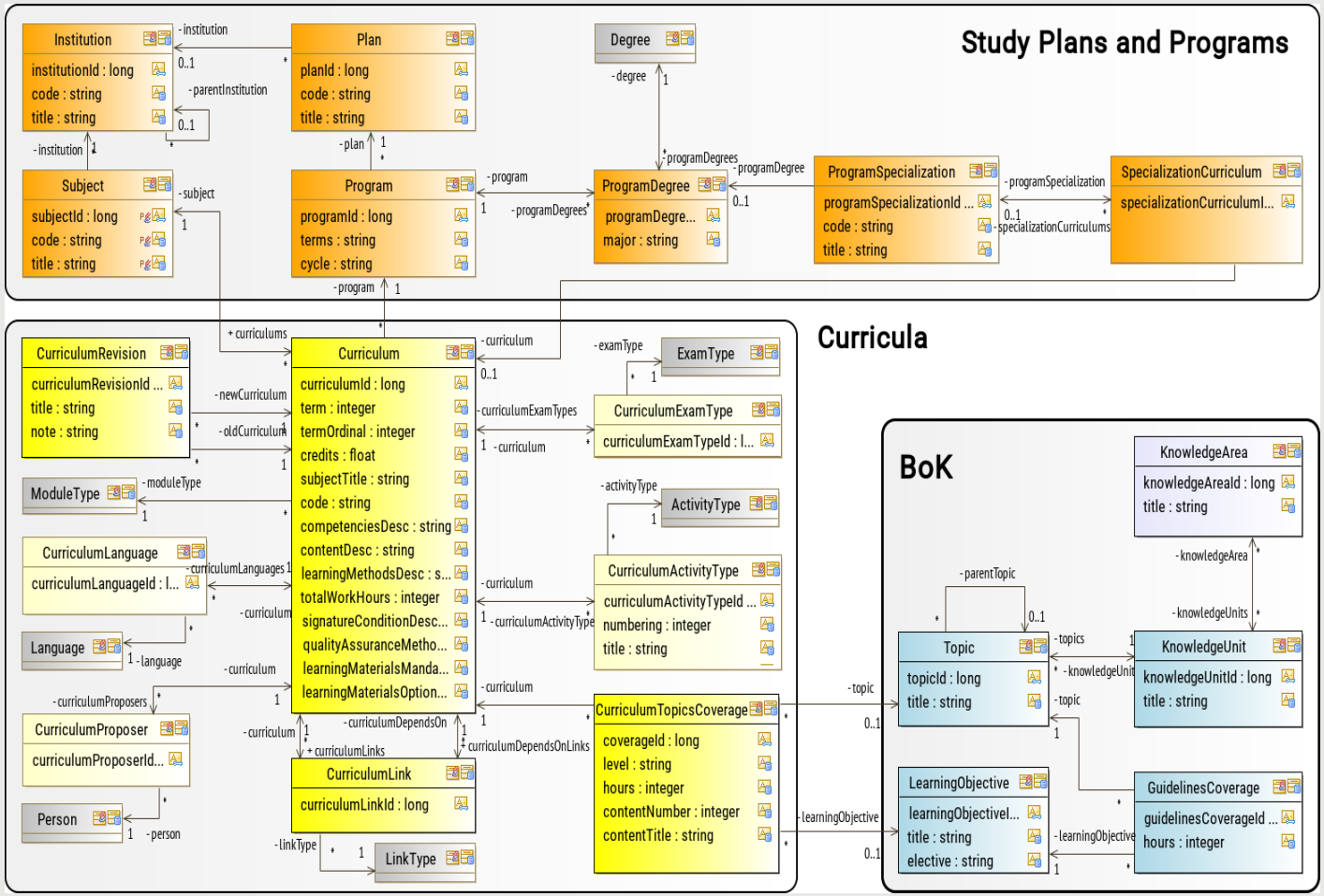
Curriculum mapping to curriculum guidelines



Analysis-Level Use-case model



Conceptual Level Design - Core of the Model

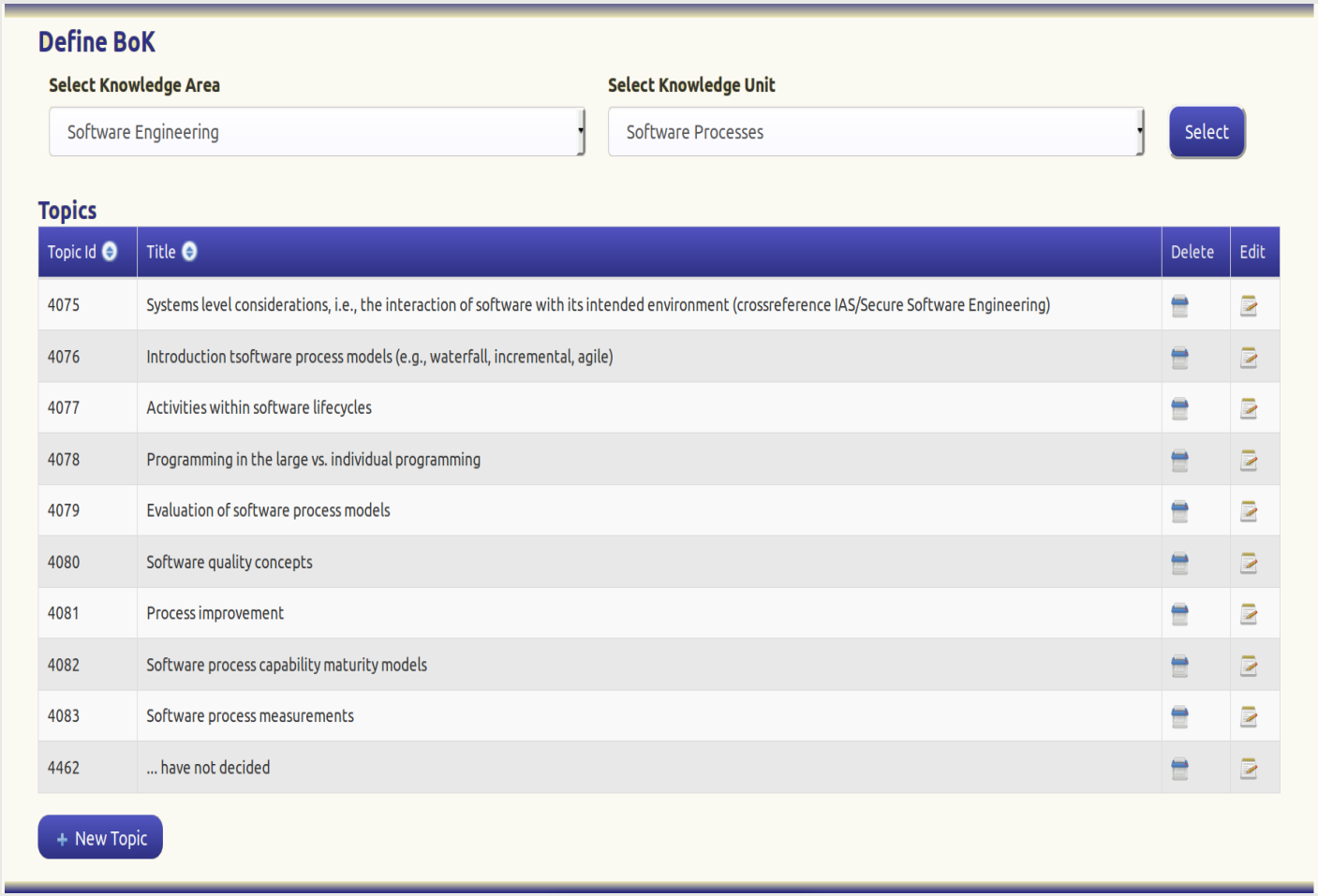


System Implementation

Contents

- PostgreSQL as a Database
- Tomcat as a Java applicatioon server
- POJO (plain old java objects) as business-logic and data-access objects services
- Hibernate as ORM (object-relational mapping)
- Tapestry as user interface and glue (dependency injection, services management)
- D3 js for visualization
- … many other small open-source libraries

Body of knowledge (ACM categorization)



Curriculum - Overview

Curriculum Overview

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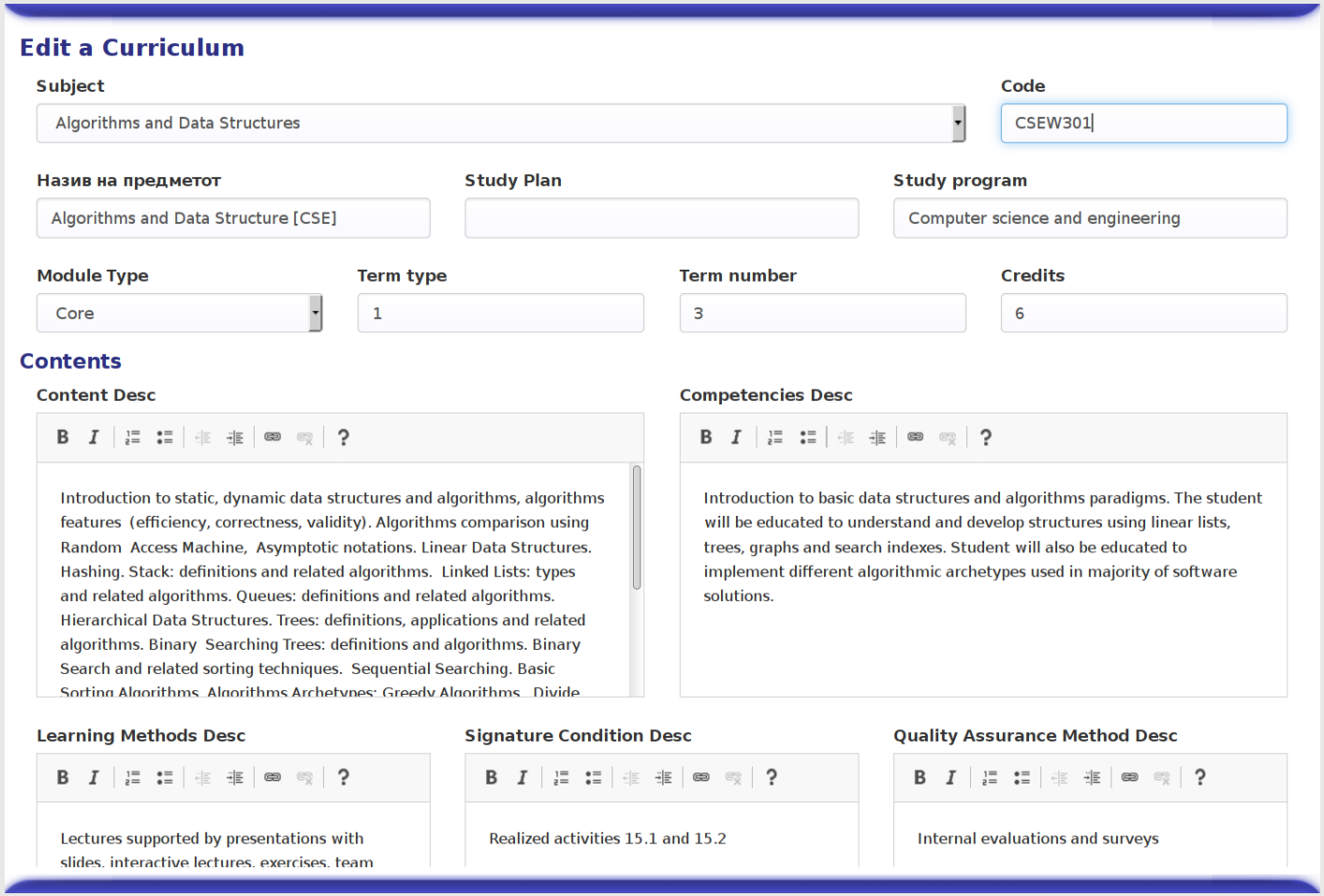
Edit Curriculum | Mapping to Guidelines | Discuss Curriculum | Create Revision

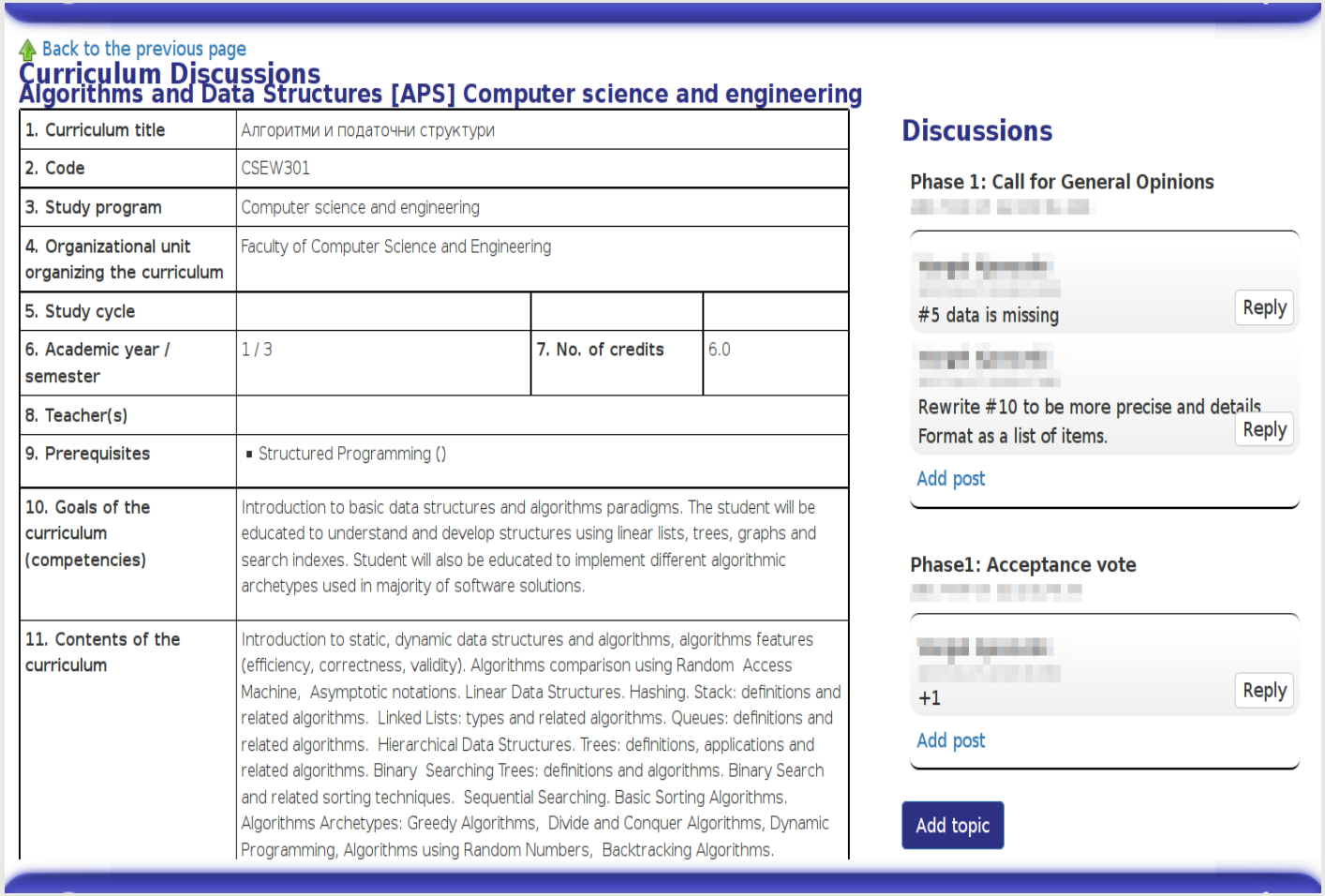
Databases[BP] for Computer Science and Engineering

1. Curriculum title	Databases		
2. Code	CSEW503		
3. Study program	Computer Science and Engineering		
4. Organizational unit organizing the curriculum	Faculty of Computer Science and Engineering		
5. Study cycle			
6. Academic year / semester	2/5	**7. ECTS Credits**	6.0
8. Teacher(s)			
9. Prerequisites for enrollment	▪ Algorithms and Data Structures (Passed exam) ▪ Object-oriented programming (Passed exam) ▪ Databases (Direct dependence (true curriculum))		
10. Goals of the curriculum (competencies)	Запознавање на студентот со основните концепти за работа со бази на податоци, начините на нивно моделирање и имплементирање, како и работа со прашалните јазици. Студентот ќе биде способен да моделира бази на податоци преку семантичко и релациско моделирање и процес на нормализација, ќе знае практично да го применува SQL стандардот за креирање, одржување и манипулација на релациските бази на податоци, ќе се здобие со воведни знаења за креирање на апликации на бази податоци.		
11. Contents of the curriculum	Вовед, историски развој, основни концепти на системи на бази податоци, споредба на процесирање датотеки и бази податоци. Управувачки софтвери на база податоци (DBMS) и архитектури, податочна независност. Модел на реалниот свет, семантичко моделирање: модел на ентитети и релации (E-R модел), проширен модел на ентитети и релации (EE-R модел), UML објектен модел (класен дијаграм). Релациски модел на бази на податоци, ограничувања на интегритет, логичка и физичка организација. Дизајн на релациски бази податоци, трансформација на EE-R модел во релациски модел. Формални прашални јазици: релациска алгебра и релациско сметање. Прашални јазици (SQL)		

Curriculum - Editing



Debating Curriculum Mapping Efforts



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Curriculum Discussions
Algorithms and Data Structures [APS] Computer science and engineering

1. Curriculum title	Алгоритми и податочни структури		
2. Code	CSEW301		
3. Study program	Computer science and engineering		
4. Organizational unit organizing the curriculum	Faculty of Computer Science and Engineering		
5. Study cycle			
6. Academic year / semester	1 / 3	7. No. of credits	6.0
8. Teacher(s)			
9. Prerequisites	▪ Structured Programming ()		
10. Goals of the curriculum (competencies)	Introduction to basic data structures and algorithms paradigms. The student will be educated to understand and develop structures using linear lists, trees, graphs and search indexes. Student will also be educated to implement different algorithmic archetypes used in majority of software solutions.		
11. Contents of the curriculum	Introduction to static, dynamic data structures and algorithms, algorithms features (efficiency, correctness, validity). Algorithms comparison using Random Access Machine, Asymptotic notations. Linear Data Structures. Hashing. Stack: definitions and related algorithms. Linked Lists: types and related algorithms. Queues: definitions and related algorithms. Hierarchical Data Structures. Trees: definitions, applications and related algorithms. Binary Searching Trees: definitions and algorithms. Binary Search and related sorting techniques. Sequential Searching. Basic Sorting Algorithms. Algorithms Archetypes: Greedy Algorithms, Divide and Conquer Algorithms, Dynamic Programming, Algorithms using Random Numbers, Backtracking Algorithms.		

Discussions

Phase 1: Call for General Opinions

[redacted]

[redacted]
#5 data is missing
Reply

[redacted]
Rewrite #10 to be more precise and details
Format as a list of items.
Reply

Add post

Phase1: Acceptance vote

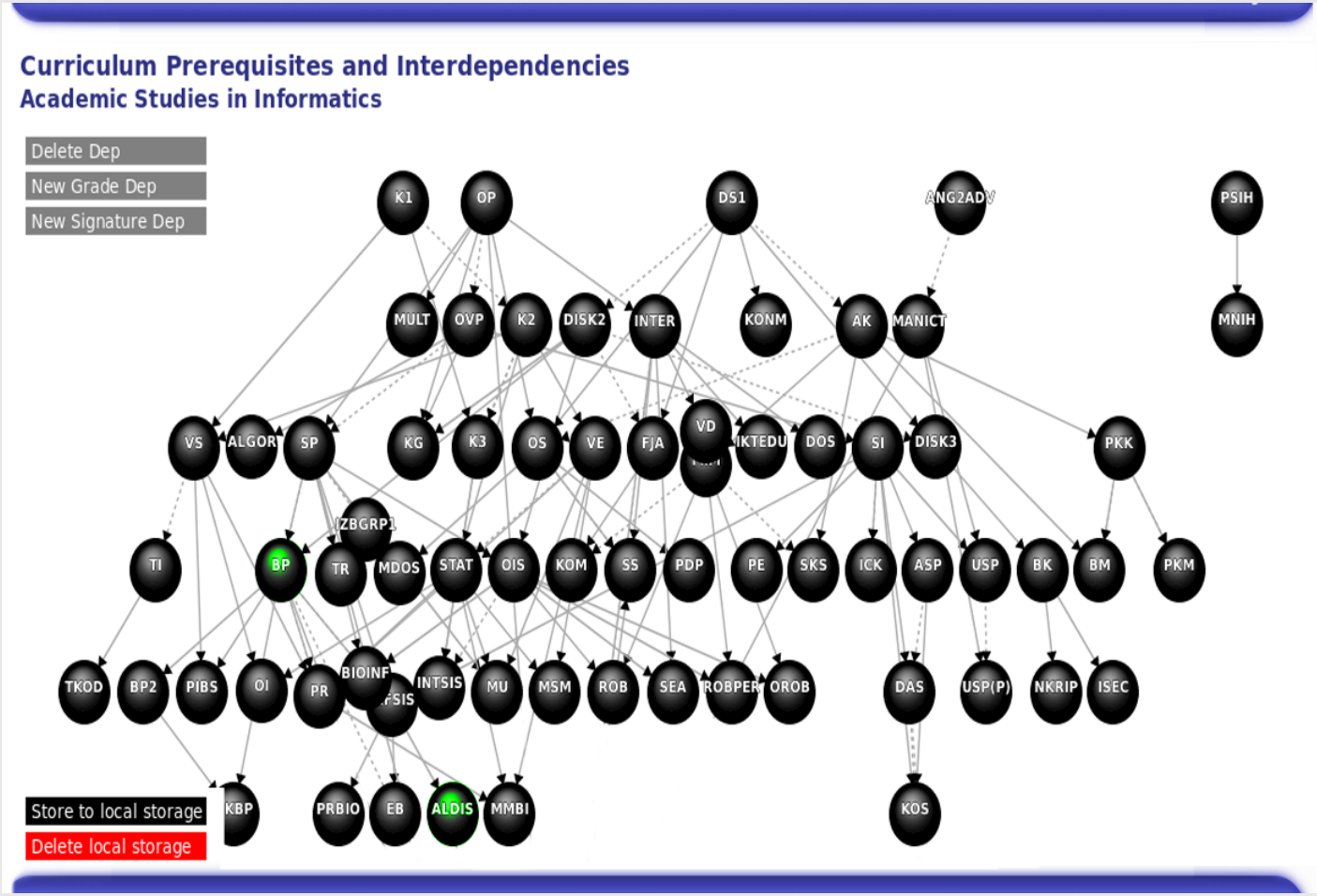
[redacted]

[redacted]
+1
Reply

Add post

Add topic

Visualization/Editing of Curriculum Relations



Curriculum Topic Mapping at the level of a Course

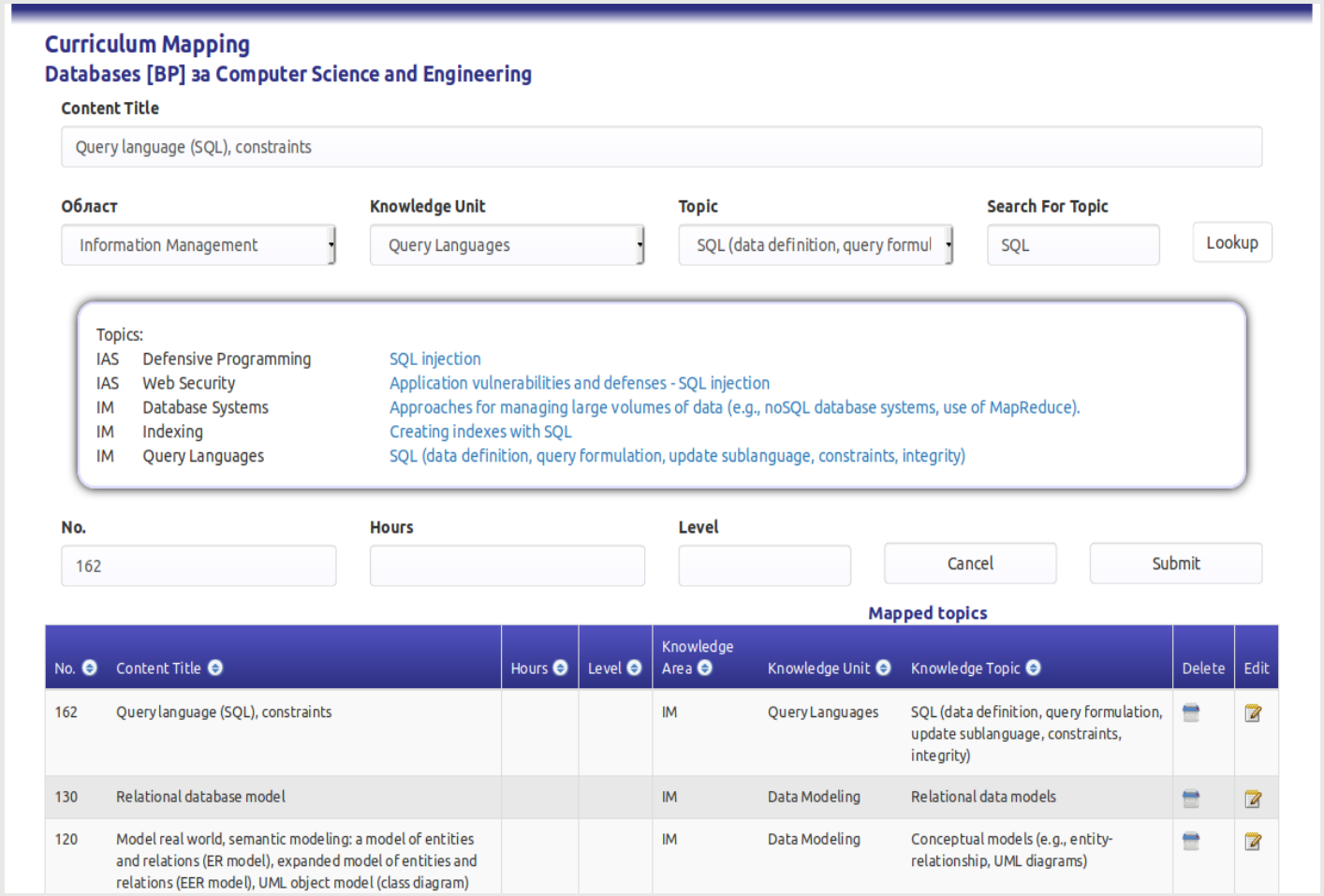
Curriculum Mapping

Databases [BP] за Computer Science and Engineering

Mapped topics

No.	Content Title	Hours	Level	Knowledge Area	Knowledge Unit	Knowledge Topic	Delete	Edit
100	Introduction, historical development, Basic concepts of systems of databases, compare processing files and databases			IM	Information Management Concepts	Basic information storage and retrieval (IS&R) concepts		
110	Database management systems (DBMS) and architectures, data independence			IM	Database Systems	Database architecture and data independence		
120	Model real world, semantic modeling: a model of entities and relations (ER model), expanded model of entities and relations (EER model), UML object model (class diagram)			IM	Data Modeling	Conceptual models (e.g., entity-relationship, UML diagrams)		
130	Relational database model			IM	Data Modeling	Relational data models		
135	Constraints of integrity, logical and physical organization ...			IM	Relational Databases	Entity and referential integrity		
140	Design of relational databases, transform the EER model relational model			IM	Relational Databases	Mapping conceptual schema to a relational schema		
150	Formal query languages: relational algebra and relational calculus			IM	Relational Databases	Relational algebra and relational calculus		
162	Query language (SQL), constraints			IM	Query Languages	SQL (data definition, query formulation, update sublanguage, constraints, integrity)		
164	triggers, stored procedures			IM	Query Languages	Stored procedures		
166	analytical queries			IM	Query Languages	Aggregates and group-by		
168	indexing			IM	Indexing	The impact of indices on query		

Curriculum Topic Mapping at the level of a Course ...



Curriculum Mapping

Databases [BP] за Computer Science and Engineering

Content Title

Query language (SQL), constraints

Област	Knowledge Unit	Topic	Search For Topic	
Information Management	Query Languages	SQL (data definition, query formul	SQL	Lookup

Topics:

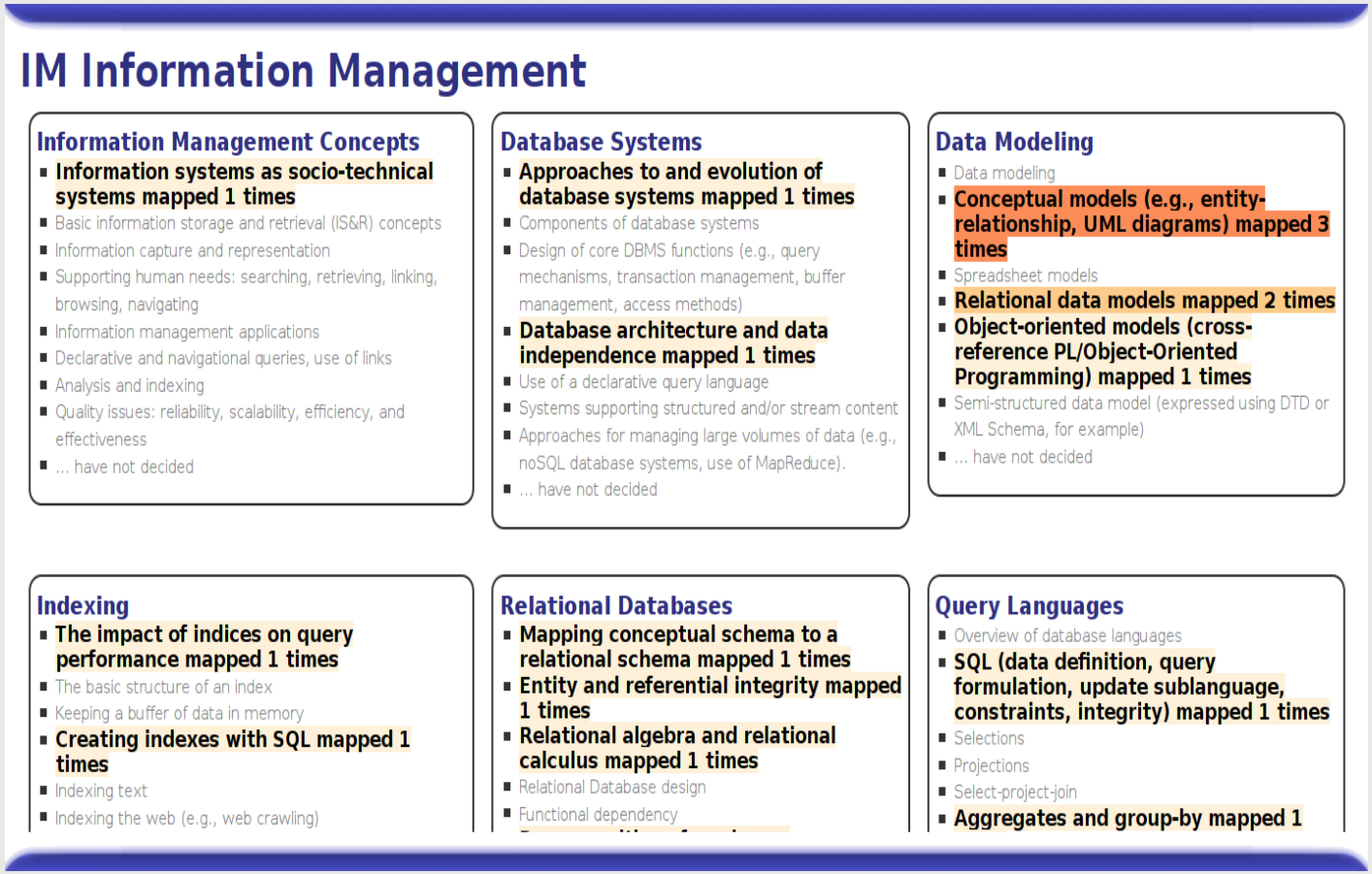
IAS	Defensive Programming	SQL injection
IAS	Web Security	Application vulnerabilities and defenses - SQL injection
IM	Database Systems	Approaches for managing large volumes of data (e.g., noSQL database systems, use of MapReduce).
IM	Indexing	Creating indexes with SQL
IM	Query Languages	SQL (data definition, query formulation, update sublanguage, constraints, integrity)

No.	Hours	Level		
162			Cancel	Submit

Mapped topics

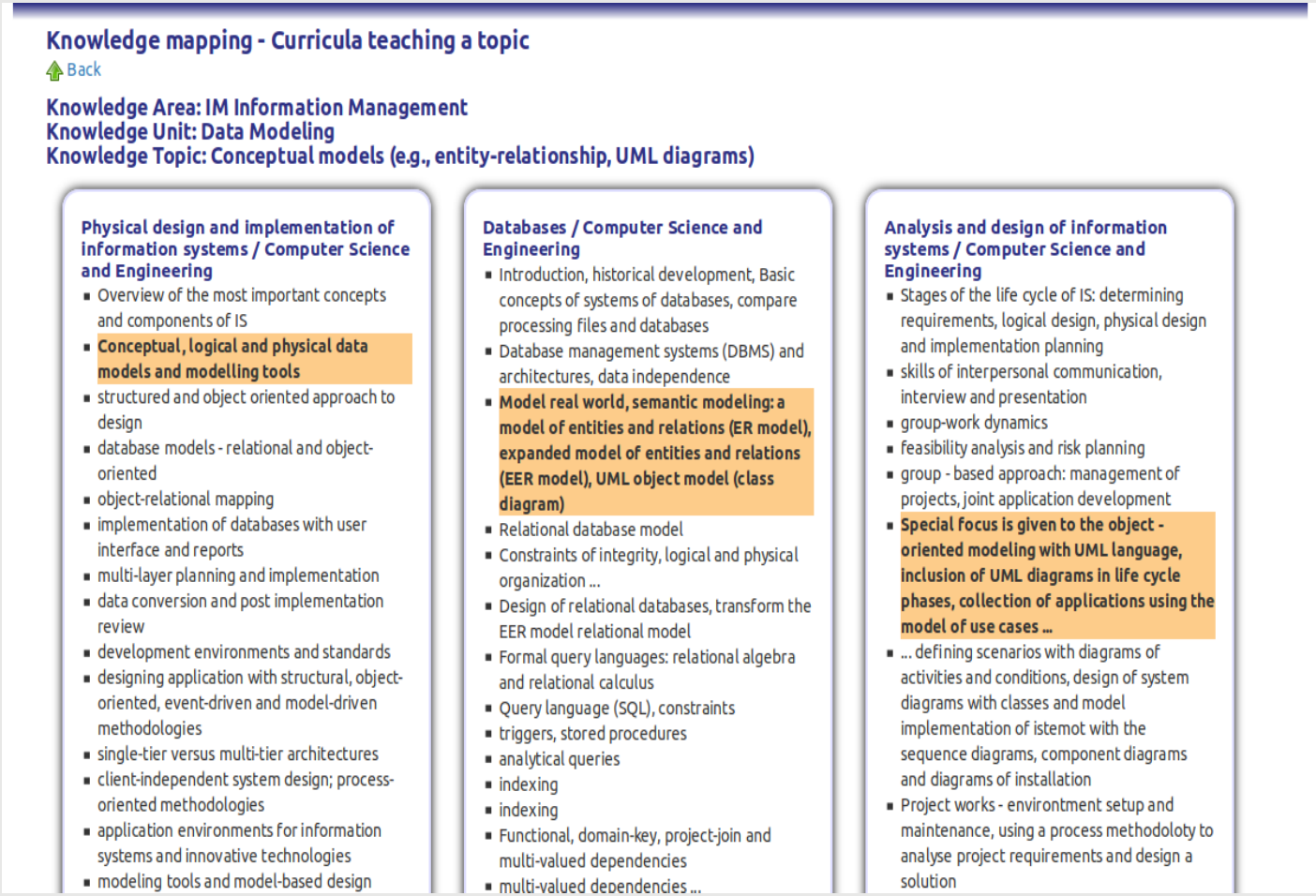
No.	Content Title	Hours	Level	Knowledge Area	Knowledge Unit	Knowledge Topic	Delete	Edit
162	Query language (SQL), constraints			IM	Query Languages	SQL (data definition, query formulation, update sublanguage, constraints, integrity)		
130	Relational database model			IM	Data Modeling	Relational data models		
120	Model real world, semantic modeling: a model of entities and relations (ER model), expanded model of entities and relations (EER model), UML object model (class diagram)			IM	Data Modeling	Conceptual models (e.g., entity-relationship, UML diagrams)		

Report: Mapped topics from the BoK



Heatmap indicates the depth of coverage of a single topic in the Curricula

Report: Inspection of mapping of a certain BoK item



Knowledge mapping - Curricula teaching a topic

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Knowledge Area: IM Information Management
Knowledge Unit: Data Modeling
Knowledge Topic: Conceptual models (e.g., entity-relationship, UML diagrams)

Physical design and implementation of information systems / Computer Science and Engineering

- Overview of the most important concepts and components of IS
- **Conceptual, logical and physical data models and modelling tools**
- structured and object oriented approach to design
- database models - relational and object-oriented
- object-relational mapping
- implementation of databases with user interface and reports
- multi-layer planning and implementation
- data conversion and post implementation review
- development environments and standards
- designing application with structural, object-oriented, event-driven and model-driven methodologies
- single-tier versus multi-tier architectures
- client-independent system design; process-oriented methodologies
- application environments for information systems and innovative technologies
- modeling tools and model-based design

Databases / Computer Science and Engineering

- Introduction, historical development, Basic concepts of systems of databases, compare processing files and databases
- Database management systems (DBMS) and architectures, data independence
- **Model real world, semantic modeling: a model of entities and relations (ER model), expanded model of entities and relations (EER model), UML object model (class diagram)**
- Relational database model
- Constraints of integrity, logical and physical organization ...
- Design of relational databases, transform the EER model relational model
- Formal query languages: relational algebra and relational calculus
- Query language (SQL), constraints
- triggers, stored procedures
- analytical queries
- indexing
- indexing
- Functional, domain-key, project-join and multi-valued dependencies
- multi-valued dependencies ...

Analysis and design of information systems / Computer Science and Engineering

- Stages of the life cycle of IS: determining requirements, logical design, physical design and implementation planning
- skills of interpersonal communication, interview and presentation
- group-work dynamics
- feasibility analysis and risk planning
- group - based approach: management of projects, joint application development
- **Special focus is given to the object - oriented modeling with UML language, inclusion of UML diagrams in life cycle phases, collection of applications using the model of use cases ...**
- ... defining scenarios with diagrams of activities and conditions, design of system diagrams with classes and model implementation of istemot with the sequence diagrams, component diagrams and diagrams of installation
- Project works - environtment setup and maintenance, using a process methodoloty to analyse project requirements and design a solution

Report: Teaching self-assessment (on-going work)

	Sem 1		Sem 2		Sem 3	
	Course1	Course2	Course3	…	…	Course n
Topic 1						
Topic 2						
Topic 3						
…						
Topic m						

Inspired by an EdMedia 2018 poster presentation

Pilot project: Experience

Contents

- Mapping over three groups of courses was performed:
  - Introductory courses
  - Databases
  - Information systems
- The main issue is that the mapping takes quite an effort:
  - The process was performed in a single program, curriculum by curriculum, topic by topic
  - It took many reconsiderations when a curriculum topic is not stated unambiguously
  - Mapping the course you teach is easy, you just need several minutes per course, but it is subjective.
  - Mapping courses taught by others needs expertise to properly conduct the mapping, and one needs to really understand what the authors of the curriculum proposal truly meant.

Proposal

Joint Research Process

- Form groups per BoK area
- Gather curriculum definitions in that area from several universities and perform iterative work:
  - Iteration 1: Mapping in pairs (initial map by person 1)
  - Iteration 1: Joint debate per area
  - Iteration 2: Mapping in pairs (adjust map by person 2)
  - Iteration 2: Joint debate per area
- Finalise mapping
- Reports and analysis

Proposal Benefits

- Easy to find partner institutions teaching the same set of topics
- Comparative analysis on curricula across the region
- Mutual unterstanding of teaching level and raising of quality
- Comparison of course offerings for locating possible student mobility targets
- … suggestions?

Future Work

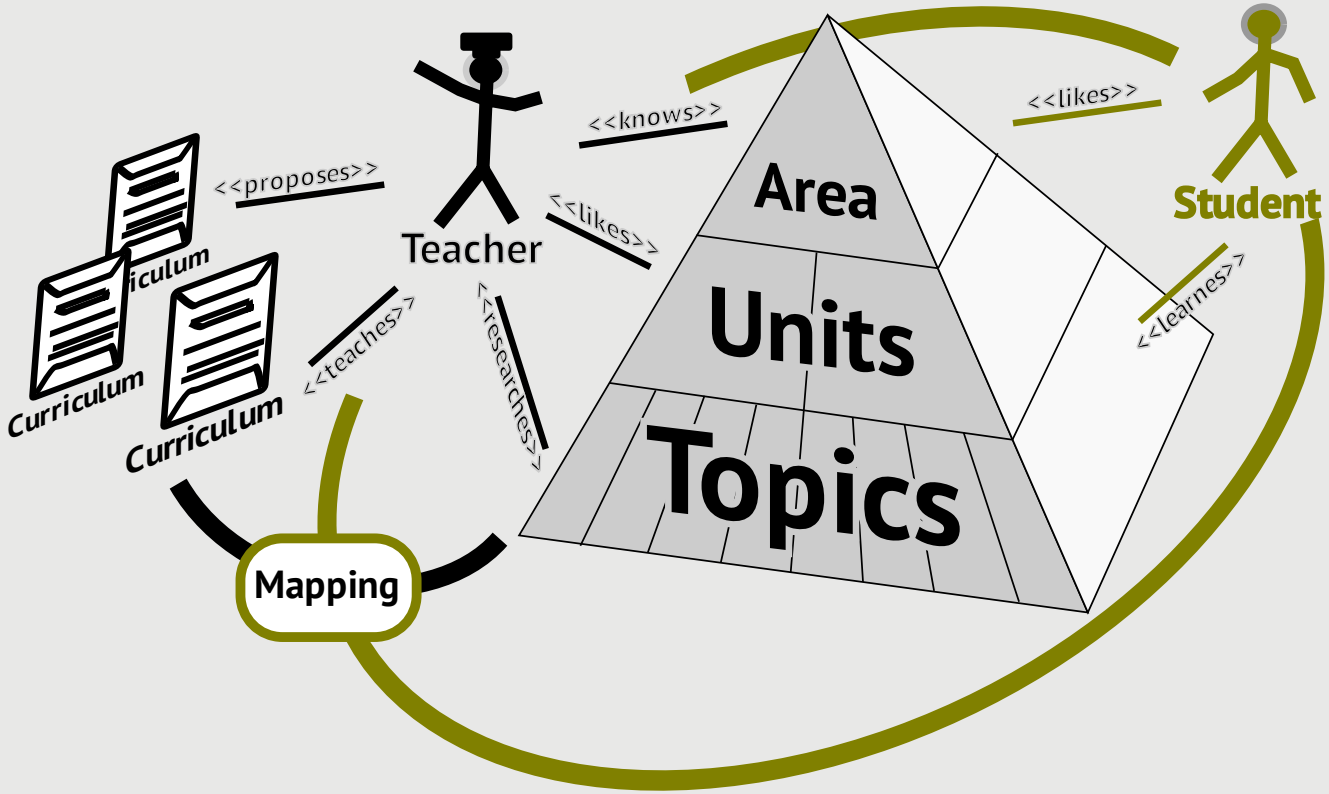
The proposed process and system should not be considered a solution for every problem and issue, but instead as a framework towards solutions starting from this core, in several directions:

- New trend is to use learning objectives and acquired skills as base of curriculum guidelines - switch to mapping objectives
- Enable multiple-BoK mapping (useful for interdisciplinary mapping)
- Measures the effects the structure of a study program and curricula have over learner success
- Comparative analysis of the evolution of student workload across curriculum revisions
- Analysis of student success from LMS logs and mapping assignment results to the Body of Knowledge items

Future and related work ...

- General human capacities' management and development with respect to teaching
- Tracking the implementation of reference curriculum guidelines in teaching week by week
- General human capacities' management and development with respect to teaching
- Mapping and tracking researchers' work to the proposed BoK within reference curriculum guidelines
- Tracking of structural curriculum evolution

Future Work Integral viewpoint



Questions and Comments?

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Acknowledgements

This research and development effort was part of the project SISng. The project was partially financed by the Faculty of Computer Science and Engineering.

SISng is envisioned as a multi-year project framework and the system that is built is open-sourced:
https://develop.finki.ukim.mk/sisng
[https://develop.finki.ukim.mk/sisng]

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