Curricular development focusing on competences and learning outcomes

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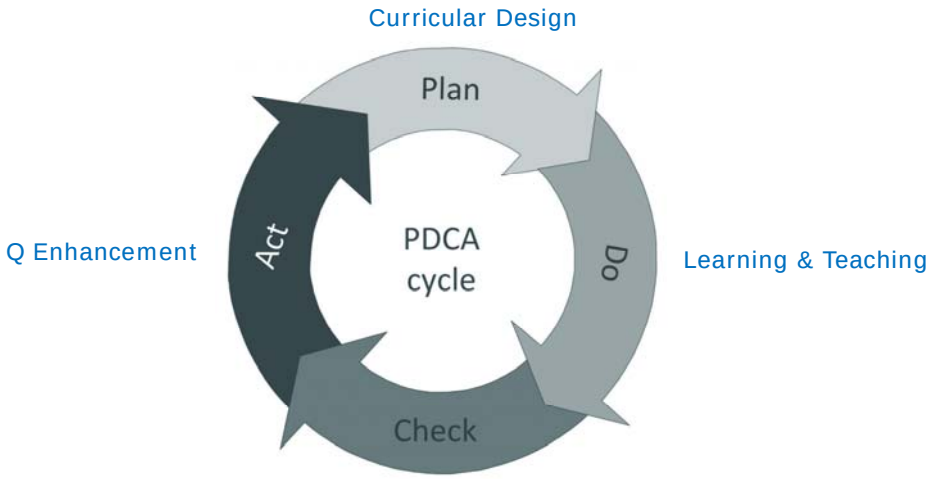
PDCA cycle of higher education



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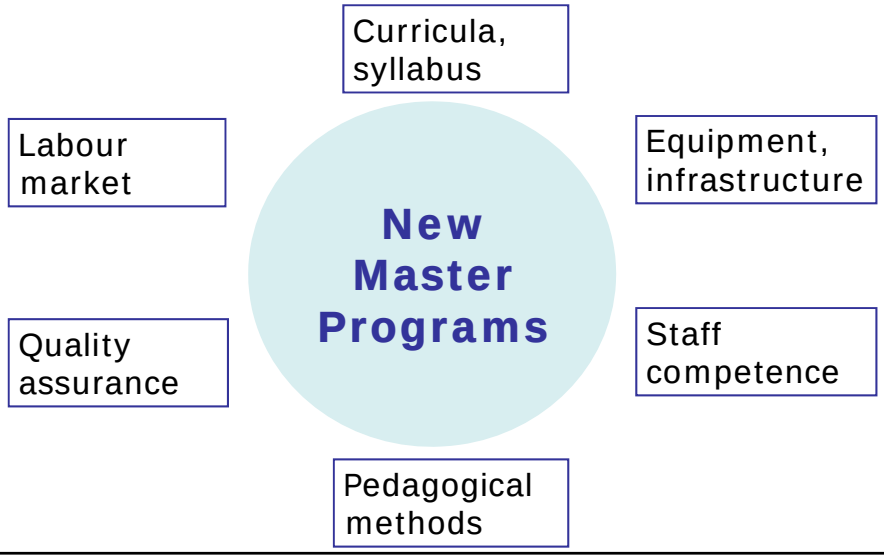
GEO4D: objectives & activities



Guidelines for higher education

- Education should serve the society in general and the labour market in particular
- Education must be updated to reflect changes in the society, in science & technology, and in expectations of new generation of students
- Education should provide students with professional competences for their future employment and personal development
- Education is meant for students and thus should be student-centered

Student-centered, active learning

- Teacher-centered teaching emphasizes the interests and expertise of teachers, while student-centered learning focuses on students's need of professional competences
- To facilitate more effective learning, we have to change philosophy: from **teaching by teachers** to **active learning by students**

What is competence ?

- A combination of knowledge, understanding, skills, capability and attitude that enables an individual to perform certain *professional* tasks
- Competences deals with "what is expected in a *professional* workplace."
- Emphasis on **performing an actual job**, not gaining knowledge/skills for their own sake or as a hobby.

Competences

- Basic parameters to compare education
- A reference of transparency for students/stakeholders
- A tool for better communication with employers and stakeholders - employability
- Benchmark for quality assurance & accreditation
- Students obtain competences through different learning activities, e.g. a series of courses (modules)

Course description: syllabus

- **Aims/objectives** of a course
  - A statement of what topics the course will cover or what the teacher wants to teach
  - *Teacher-centered, process-centered*
- **Learning outcomes** of a course
  - A statement of what students will know, understand and be able to do after the course
  - *Student-centered, output-centered*

Competences vs Learning Outcomes

- Competences concern a study programme, while LOs address individual courses (modules, subjects)
- Desired competences are defined on the basis of input from internal and external stakeholders (e.g. employers)
- LOs are statements of what a student is expected to know, understand and be able to do after completion of a course
- LOs are mostly formulated by the teaching staff, taking into account the programme's desired competences

Competences and Learning Outcomes

- Learning/teaching activities help students to learn
- Assessment activities make sure that students have achieved the stated **Learning Outcomes**
- **Learning Outcomes** lead to skills/**Competences**
- **Competences** make graduates employable and useful for the society

Competences of a study programme

(LOs at programme level)

- Knowledge and understanding of the subject
- Practical skills
- Intellectual skills, higher level thinking skills
- Generic (transversal/transferable) skills

Competences for MSc in *Geodesy and Geoinformatics*

1) Broad knowledge in land survey, mapping and GIS
2) specialised knowledge in certain areas and current research topics

3) Practical skills to do measurements, process field data and evaluate the results
4) Practical skills to structure, visualize and analyze spatial data using GIS software

5) Ability to choose proper methods for specifc conditions and requirements
6) Skills to evaluate possibilities and limitations of existing methods
7) Insight on the needs of new technologies/solutions in geodesy/geoinformatics

8) Be able to communicate effectively and present scientific work in oral/written form
9) Project management skills and ability to work in group and in project form
10) Insight on ethical, environmental and sustainable development issues and their relevance in professional work

MSc in *Geodesy and Geoinformatics*

1) Adjustment theory (7,5c)
2) Map projections & reference systems (7,5c)
3) Global Navigation Satellite Systems (GNSS) (7,5c)
4) Physical geodesy (7,5c)
5) Laser scanning technologies (7,5c)
6) Integrated navigation (7,5c)
7) Spatial databases (7,5c)
8) Geovisualization (7,5c)
9) GIS architecture (7,5c)
10) Spatial analysis (7,5c)
11) Remote sensing and image processing (7,5c)
12) GIS project (7,5c)

13) MSc thesis project (30c)

The Competence Matrix for *Geodesy and Geoinformatics*

COMPETENCES \ COURSES	01. Adjustment theory	02. Map projections & RS	03. GNSS	04. Physical geodesy	05. Laser scanning	06. Engineering geodesy	07. Spatial databases	08. Geovisualization	09. GIS architecture	10. Spatial analysis	11. Image processing	12. GIS project
broad knowledge in land survey, mapping and GIS	X	X	X	X	X	X	X	X	X	X	X	X
specialized knowledge in some areas and current research topics	X	X	X	X	X	X	X	X	X	X	X	X
practical skills to carry out measurements, process field data and evaluate results	X	X	X		X	X						
practical skills to structure, visualize and analyse spatial data using GIS					X	x	X	X	X	X	X	X
ability to choose proper methods for specific conditions and requirements		X	X		X	X		X		X		X
ability to evaluate possibilities and limitations of existing geodetic methods		X	X		X	X						X
insight on needs of new technologies and new solutions in geodesy and geoinformatics			X	X	X	X	X	X	X	X	X	X
skills to communicate effectively					X	X				X	X	X
ability to manage project and work in groups & project form					X	X				X		X
awareness on ethnical issues as wel as climate change + sustainable development				X	X	X	X			X		X

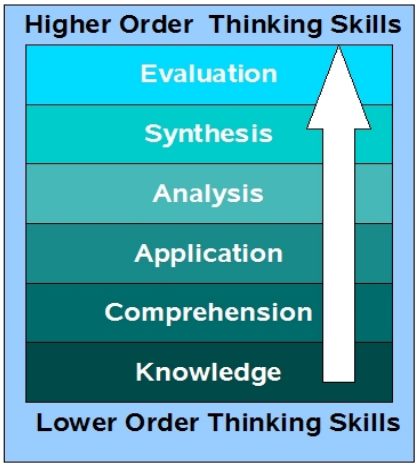
585718-EPP-2017-HU **DSinGIS**

	Competences from doctoral studies in GeoInformation Scienecs
	Professional competences in GIScience
1	Advanced skills in analyzing, integrating and managing spatial data
2	Skills to design GIS systems and services
3	Ability for innovations in designing, managing and implementing GIS projects
4	Ability to solve complex spatial problems in global context
5	Knowledge and skills to address challenges in defining and maintaining geodetic reference systems
6	Ability to investigate limitations and possibilities of GNSS for high accuracy positioning and navigation
7	Deep insight on earth's gravity field and the geoid and their applications in geodesy and earth sciences
8	Skills to initiate geographic/land/cadastral etc. information systems
	Research competences
9	Insight on current research activities in GI Sciences
10	Ability to critically evaluate existing theories and technologies and identify the needs of further research for improvement
11	Ability to design scientific experiments, interpret experiment results and seek solutions based on sound scientific methods
12	Ability to apply multi-disciplinary approaches to solve scientific problems
	Generic competences (soft skills)
13	Ability to communicate effectively in oral or written form, to both specialist and non-specialist audiences
14	Ability to choose and use right social media for publishing and communicating
15	Leadership skills and ability to work in project team and in multi-disciplinary environment
16	Innovation and entrepreneurial skills to widely use research results and innovation ideas
17	Ability to engage in life-long learning
18	Awareness of ethic, economic and professional issues, as well as sustainable development issues

Learning outcomes

- In a learning process, learning/teaching activities (lessons) are input, while LOs are the expected outputs.
- LO are not a repeat of titles of lessons in a course, rather **what student should know, understand, be able to do** after the lessons.
- It should be possible to assess if a student has achieved the stated LOs or not.
- LOs can be formulated using active verbs, from Bloom's taxonomy

Bloom's Taxonomy (1956)



Action verbs

Evaluate

Synthesize

Analyze

Apply

Understand

Know

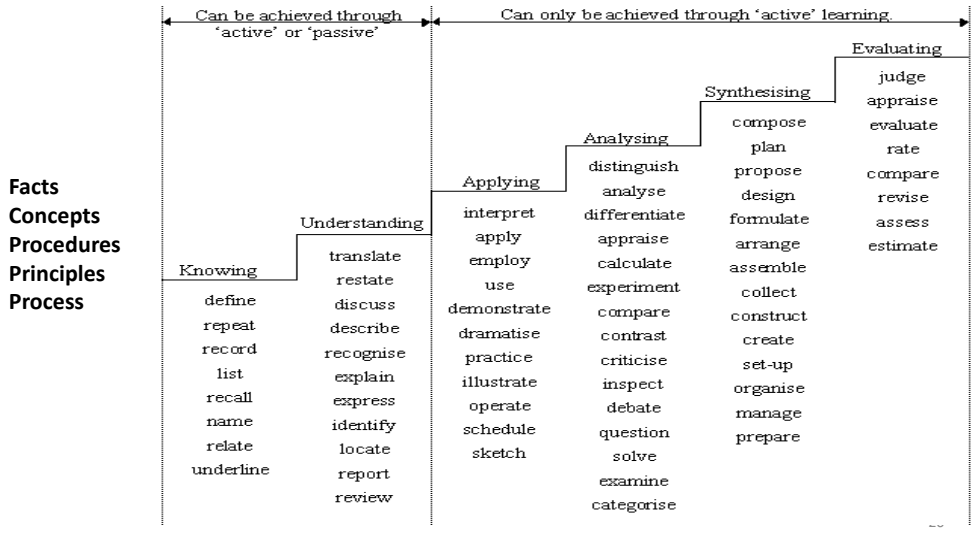
Bloom's Taxonomy (1/2)

1. **Knowledge** (*recalling important information*) – e.g. define, repeat, record, list, recall, name, relate, underline.
2. **Comprehension** (*explaining important information*) – e.g. discuss, describe, recognize, explain, identify, locate, report, review, tell
3. **Application** (*solving close ended problems where there is a clear answer*) – e.g. interpret, apply, employ, use, demonstrate, dramatize, practice, illustrate, operate, schedule, sketch.

Bloom's Taxonomy (2/2)

4. **Analysis** (*solving open problems where there is no single clear answer*) – e.g. distinguish, analyse, differentiate, appraise, calculate, experiment, test, compare, contrast, criticize, diagram, inspect, debate, question, relate, solve, examine, categorize
5. **Synthesis** (*creating unique answers to open problems*) – e.g. compose, plan, propose, design, formulate, arrange, assemble, collect, construct, create, set up, organize, manage, prepare.
6. **Evaluation** (*making critical judgements based on sound knowledge base*) – e.g. judge, appraise, evaluate, rate, compare, revise, assess, *estimate*

Bloom's taxonomy



Bloom's Taxonomy (revised)

Higher order thinking skills

Create

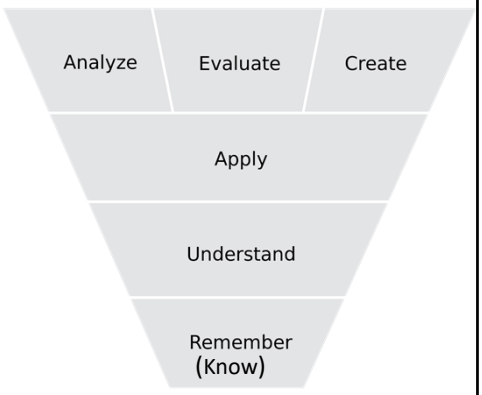
Evaluate

Analyze

Apply

Understand

Know



Lower order thinking skills

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Syllabus of one course

Course code	AH2922
Course name	**Map projections and reference systems**
Semester / year	1 / 1
ECTS credits	7,5c
Language of instructions	Swedish or English
Study hours	Lecture: 28 hours Exercise: 36 hours Project: 24 hours Self-study: 112 hours Total: 200 hours (27 hours per ECTS credit)
Learning outcomes	After completion of this course, students should be able to 1) describe the geometry of the reference ellipsoid 2) computer geodetic lines on the reference ellipsoid 3) analyse, compare and select map projections for different applications 4) calculate projection coordinates for commonly used map projections 5) understand how astrogeodetic networks, height systems and modern 3D reference systems are constructed 6) understand astro-geodynamic phenomena and their influences on celestrial and terrestrial reference systems 7) transform coordinates between different reference systems.
Syllabus (contents, lessons)	List of lectures (2h each): 1. Geometry of the earth sphere and earth ellipsoid 2. Coordinate systems on the ellipsoid 3. Geodetic lines and basic geodetic problems 4. Classification of map projections. General projection theory. 5. Azimuthal projections. Conical projections 6. Cylindrical projections. Gauss-Kruger projections. UTM. 7. Spherical astronomy 8. Astro-geodetic triangulation. Geodetic datums. 9. Gravity, geoid and height systems 10. Geodynamics: plate tectonics, land uplift, earth tide, sea level change 11. Earth rotation: polar motion, precession and nutation. Earth orientation parameters (EOP). 12. Celestial vs. terrestrial reference systems (ICRS, ITRS) 13. Existing reference frames: ITRF 2005, WGS 84, EUREF 89, SWEREF 99, RT 90, RH 70, SWEN08LR. 14. Transformation between 3D coordinate systems. Estimation of 3D Helmert transformation parameters.

Tasks of curricular workshop in Leon

- Define the competences of a new MSc program
- Design a list of courses (modules) in the program
- Specify LOs and lessons for each course

  (using a standard template)
- Create a competence matrix (CM).

  Make sure that no row of CM is empty