ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Using learning outcomes to make student workload more visible

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Bern – March 11, 2015

Welcome!

At the end of this workshop you should be able to:

- Explain to your colleagues how **student workload (SW)** and **learning outcomes (LO)** are **related**
- Decide if an **interface for LO**, similar to the one of EPFL, is adaptable to your circumstances

Introduction

Tell us:

- Who are you?
- What are your concerns about ‘student workload’?

Learning Outcomes

A clear, concise statement of what a student must be able to do at the end of the instruction period.

Poor example

- Understand the concept of conflict of interest and its relevance to pharmacists.

Better examples

- Provide examples of conflict of interest pertinent to pharmacists.
- Identify specific situations where a conflict of interest exists.

Activity 1: The main question

1. Individually, write down your answer to the following question (1 min)

   How are learning outcomes and student workload related?

2. Share your answer with the person sitting beside you (4 min)

3. Plenum: agreements, disagreements, questions left open (5 min)

L.O. + S.W.

- ECTS allocation.
- Mark the differences between content transmission and content application.
- Greater coherence with programme outcomes.
- Trace transversal skills across a programme.

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EPFL Course Description Project (2013)

Goals of the project

- **All courses** to be described in terms of learning outcomes by Spring 2014

- Learning outcomes to provide **useful** information to students, teachers, programme managers and the wider public

Challenges

- Writing of Learning Outcomes in the **right format** (observable, action verbs, etc.)
- Obtaining an **overview of the cognitive difficulty** of courses across the curriculum
- Ensuring a **coherent** and **non abusive** inclusion of **professional / transversal competences**
- Improving the **alignment** of student workload – learning outcomes – instructional strategies

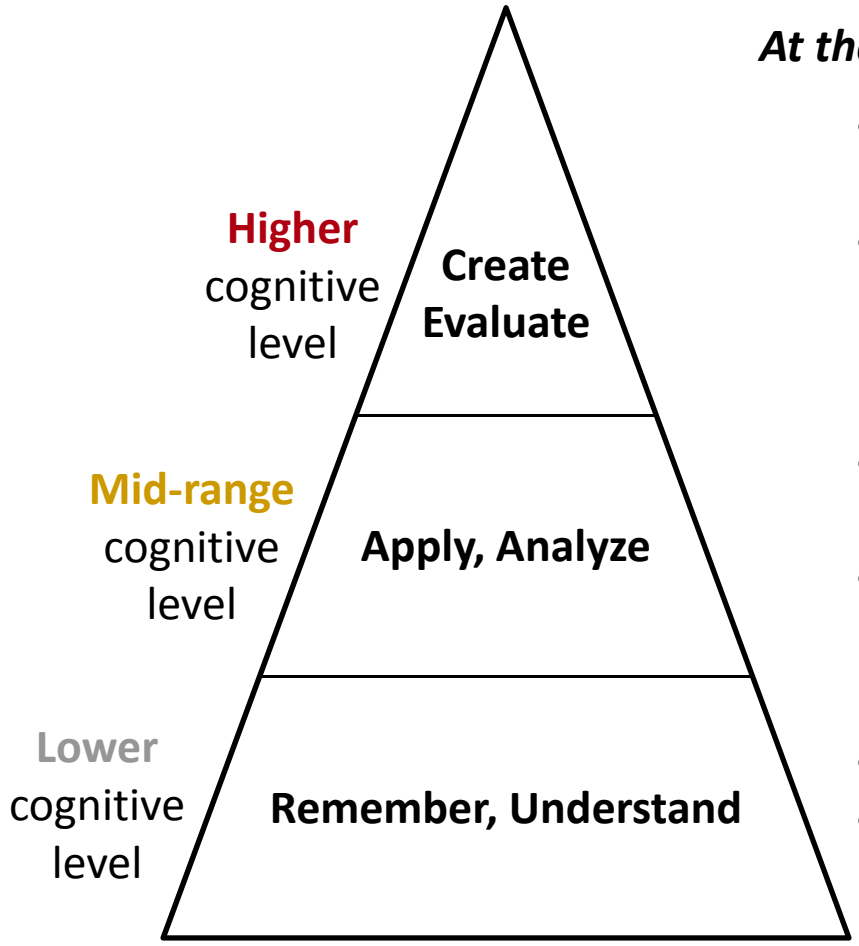
Implementation

- Development of a web-based Course Description **interface** (‘fiche de cours’) with multilingual support

- Launched in May 2013, **deadline** November 2013

Subject competences

- Simplified cognitive levels
- Fixed set of observable verbs for each level
- Freely defined context



At the end of the course the students must be able to:

- ***Design*** mechatronic systems (choice of sensors, actuators, embedded systems)
- ***Evaluate*** the performance of a closed loop system, drawing on simulation or experimental data, and draw conclusions

- ***Compare*** the performance of JFET and Bipolar Transistors
- ***Model*** the internal logistics of a production and distribution system

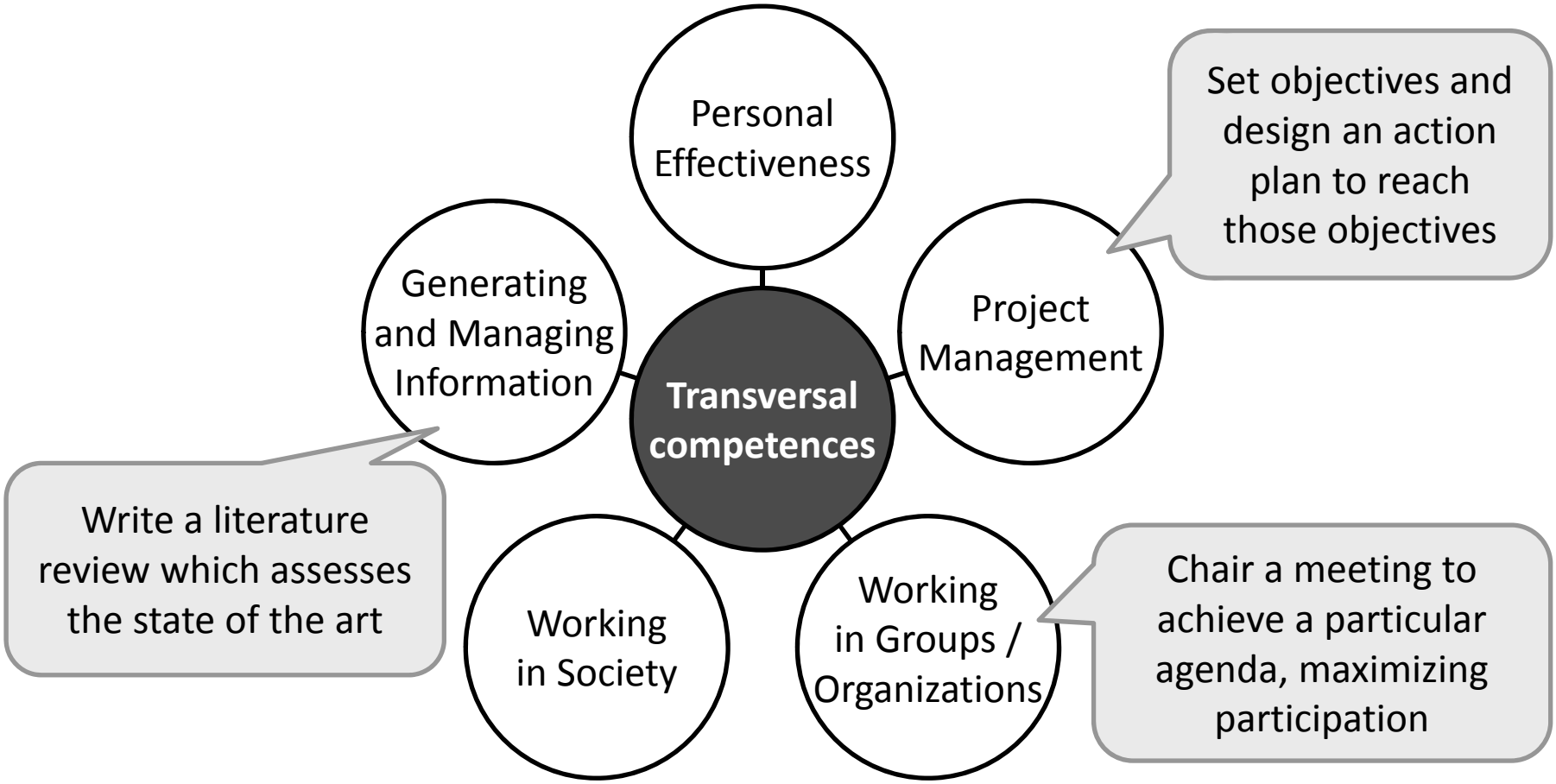
- ***Define*** the concept of thermodynamic efficiency
- ***List*** and explain the hygiene and safety rules applicable to biomechanical testing of tissues

Bloom (1956), Krathwohl (2002)

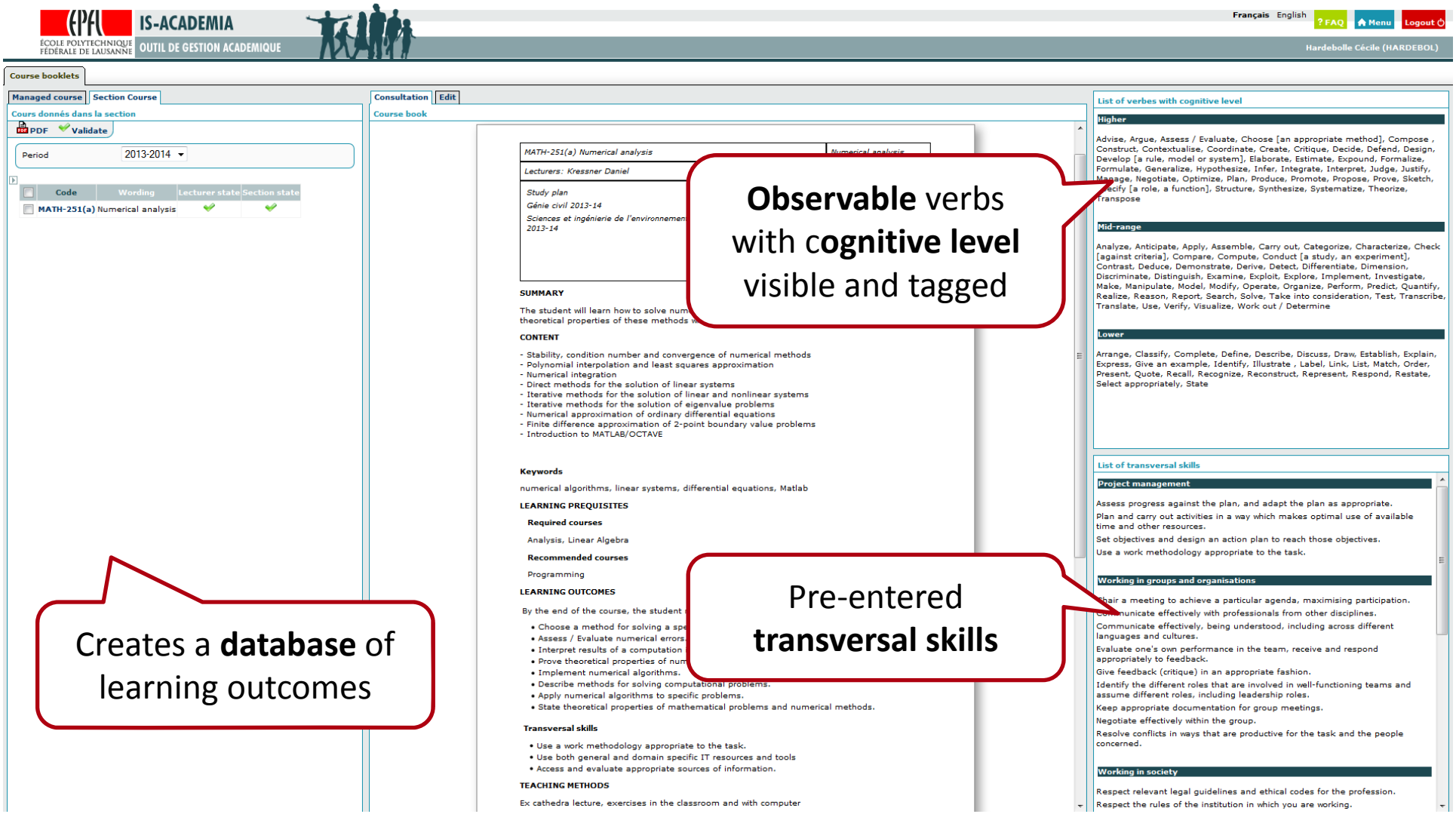
Transversal competences

- Pre-entered set of skills
- 5 categories of professional & personal competences

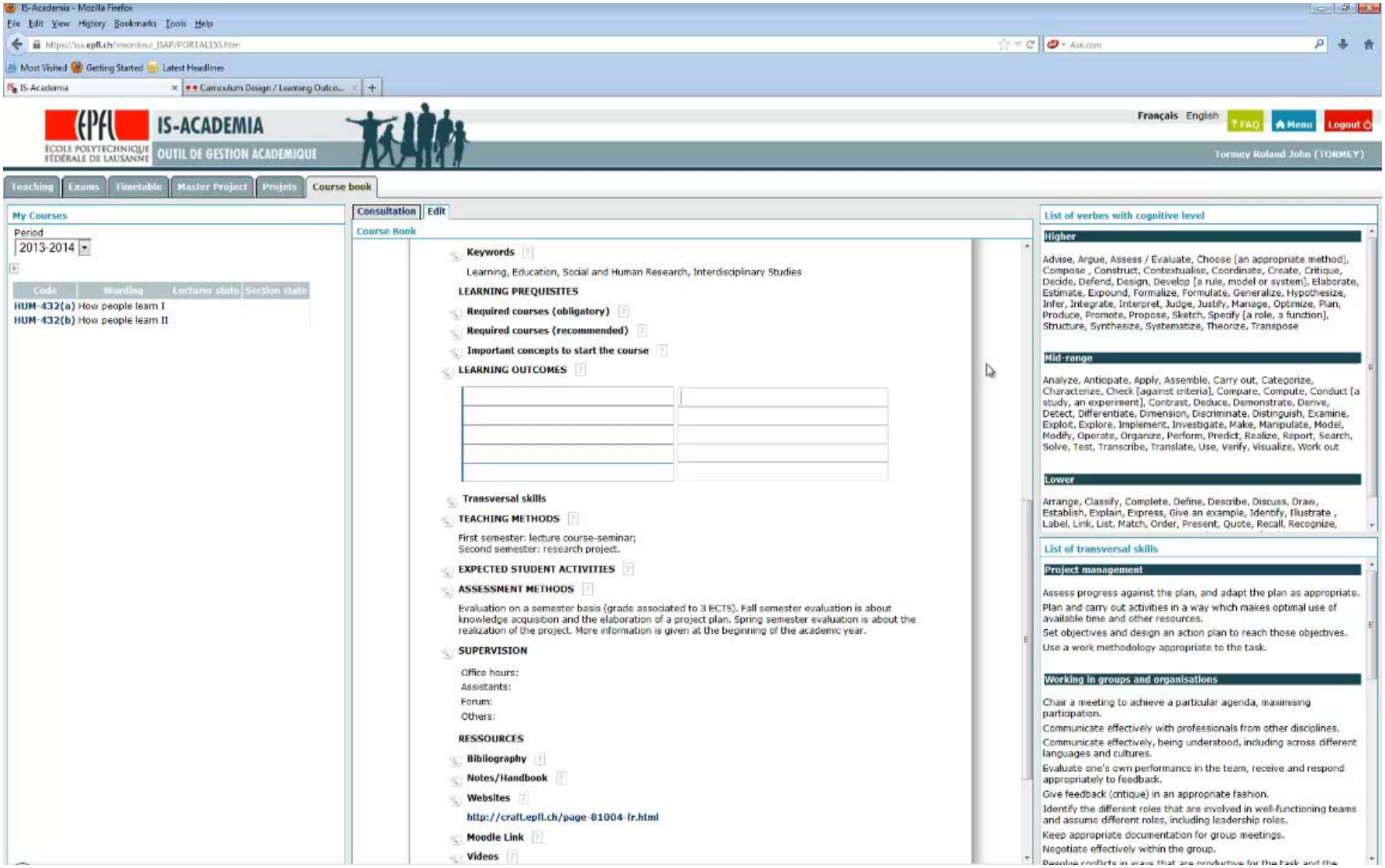
At the end of the course the students must be able to:



Interface for creating learning outcomes

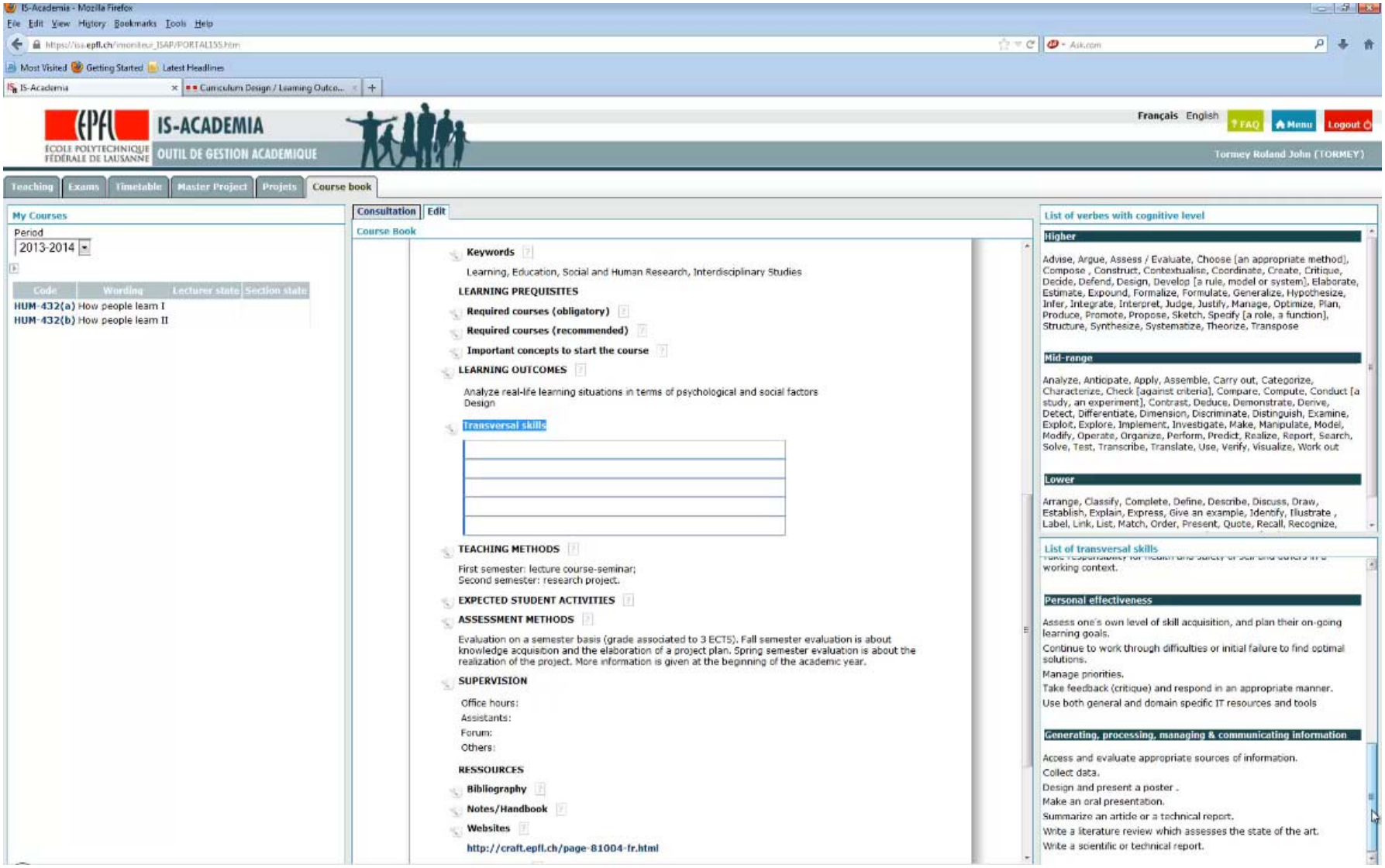


Demo: subject competences (1')



http://cape.epfl.ch/assistance-course-description

Demo: transversal competences (30”)



http://cape.epfl.ch/assistance-course-description

Resources & Support

- Information website
  - Advice, checklist and FAQ on **LO**
  - Screencast tutorial and FAQ on the **interface**
- ABC on LO (‘How To’ guide)
- Trainings
- Hotline

Some interesting results

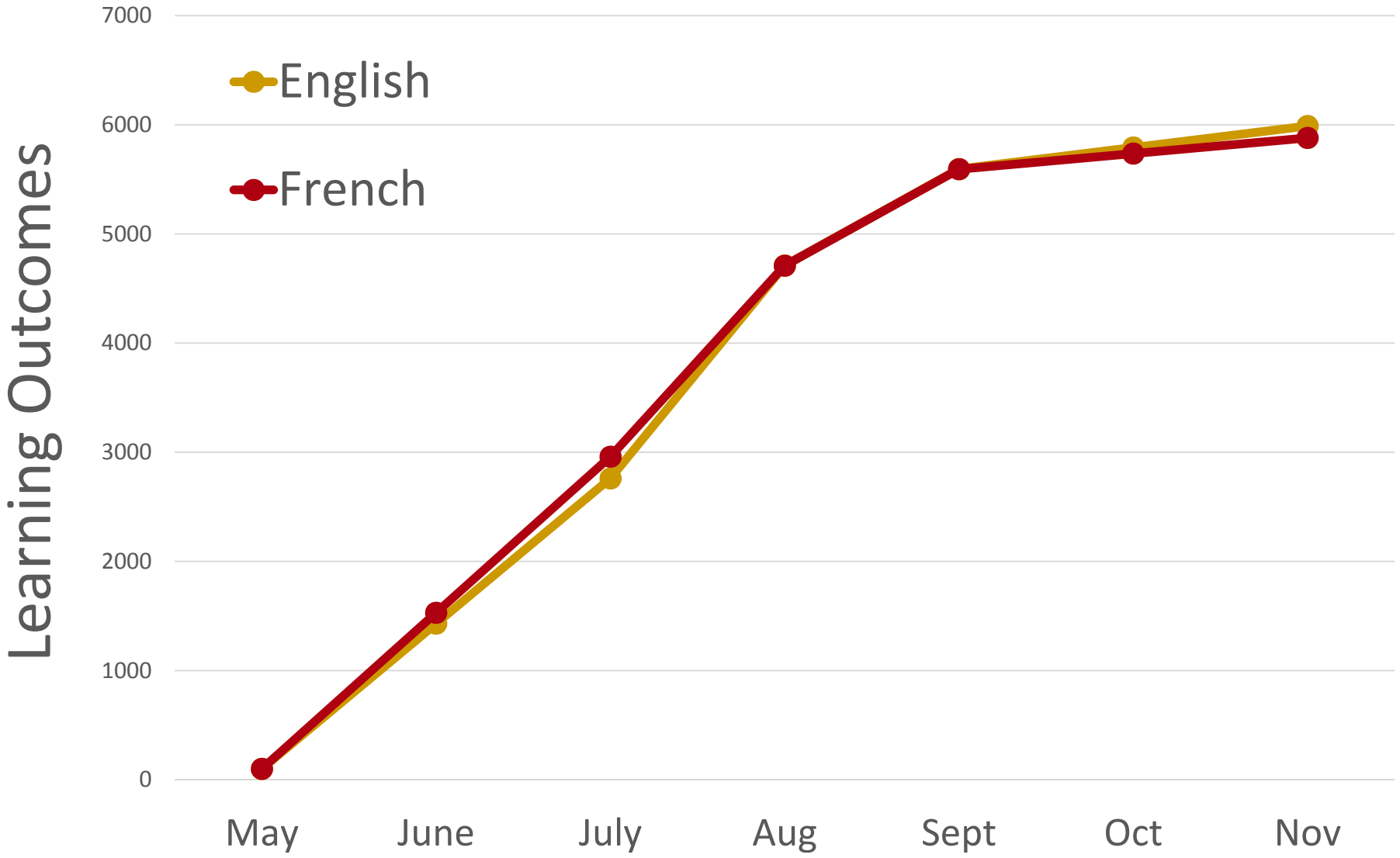
1. Interesting **discussions** with teachers on learning

2. High **number of courses** are now described with learning outcomes

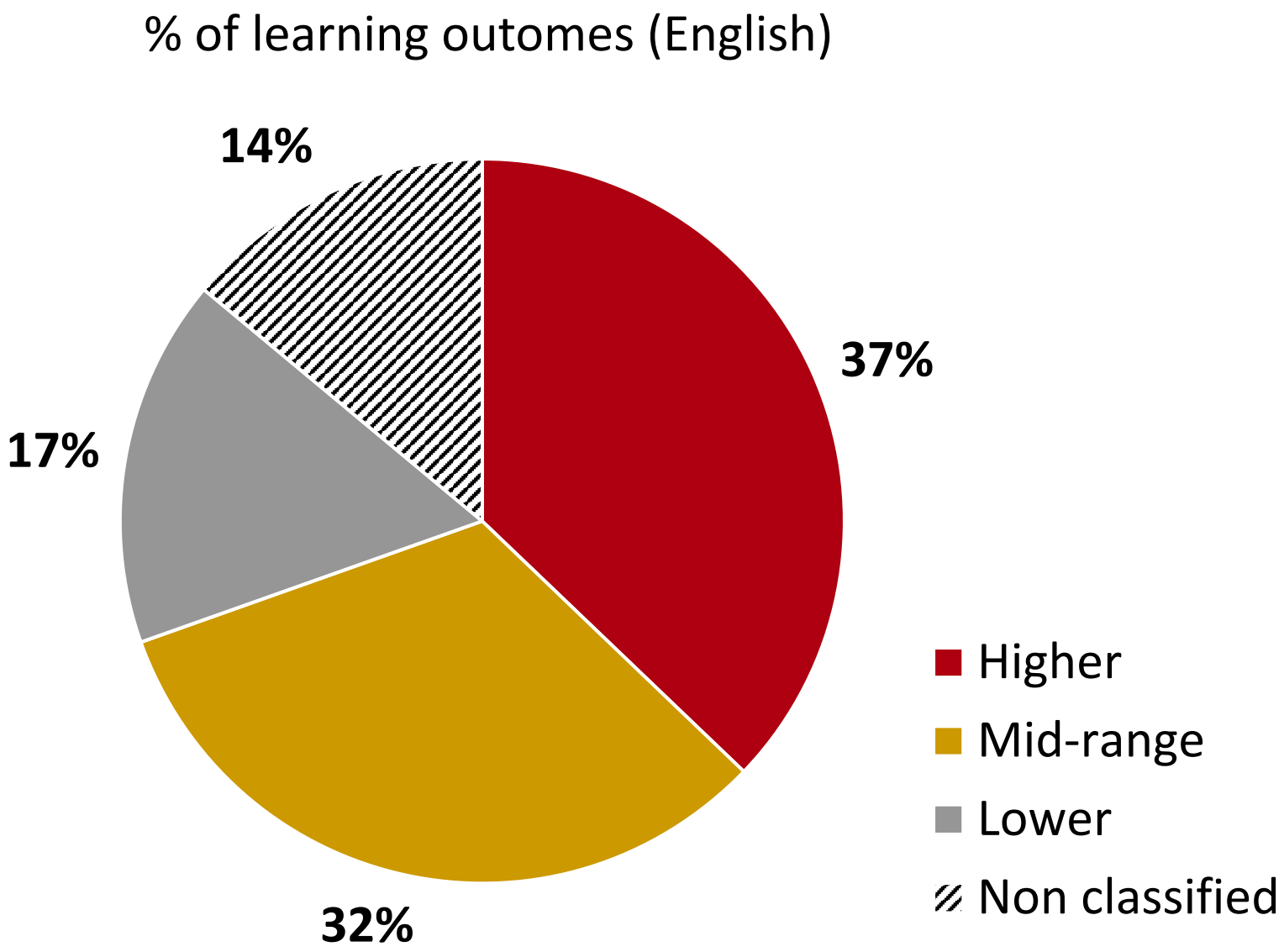
3. A wide range of **subject competences** are represented at all **three cognitive levels**

4. **Transversal skills** shown to be present not only in specific type courses, but **across the curriculum**

“Quantity” of Learning Outcomes 2013



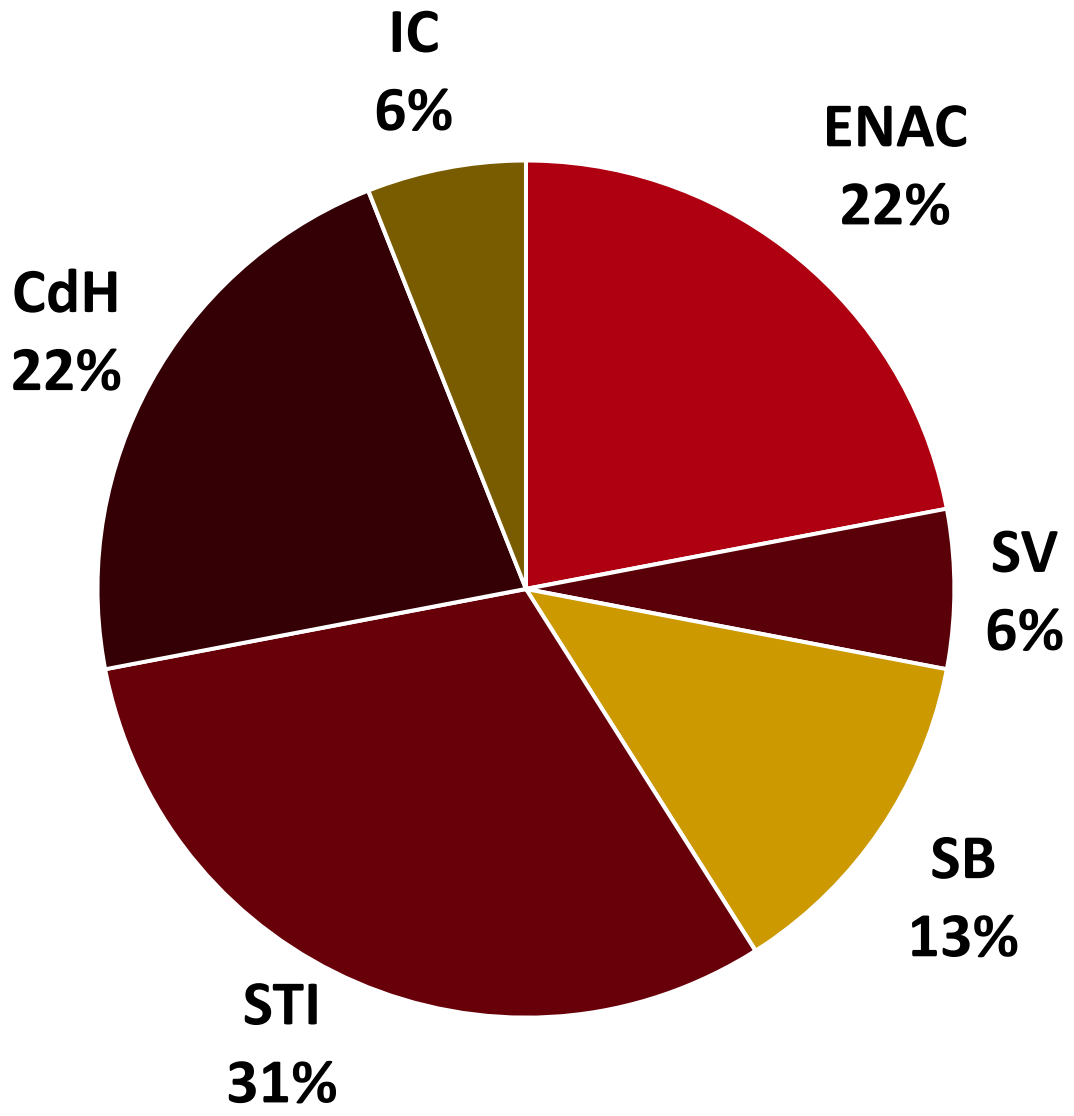
Level of cognitive skills represented



47% of courses include Transversal LO

710 courses

Variation across different programs



Activity 2: Transfer

1. Write down a response to one or several of these questions (3 min).
   a. What would help **teachers** define the workload starting from LO?

   b. What effect would it make for **students** to have LO and SW formally written and in advance?

   c. In terms of **programme management**, what suggestions for change can be made?

2. Plenum: let's share answers (10 min)

Conclusion

- EPFL's **interface sparked reflection** on LO and SW, while achieving a major administrative goal
- Results show teachers' **awareness to transversal skills** in scientific as well as social science courses

- Drafting a course description in terms of LO helps to **make SW visible**
- Defining *what* students shall be able to do promotes **coherence** between instructional strategy, LO and SW (alignment)

Consultation | Edit

Course book

MATH-251(a) Numerical analysis			Numerical analysis
Lecturers: Kressner Daniel			Language : English
Study plan	Semester	Mand. Option Filières	Credits: 3
Génie civil 2013-14	BA5	x	Number of hours A week :3h
Sciences et ingénierie de l'environnement 2013-14	BA5	x	Distribution: Lecture : 2h hebdo Exercises : 1h hebdo

SUMMARY

The student will learn how to solve numerically some relevant mathematical problems. The theoretical properties of these methods will be discussed.

CONTENT

- Stability, condition number and convergence of numerical methods
- Polynomial interpolation and least squares approximation
- Numerical integration
- Direct methods for the solution of linear systems
- Iterative methods for the solution of linear and nonlinear systems
- Iterative methods for the solution of eigenvalue problems
- Numerical approximation of ordinary differential equations
- Finite difference approximation of 2-point boundary value problems
- Introduction to MATLAB/OCTAVE

Keywords

numerical algorithms, linear systems, differential equations, Matlab

LEARNING PREQUISITES

Required courses

Analysis, Linear Algebra

Recommended courses

Programming

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose a method for solving a specific problem.
- Assess / Evaluate numerical errors.
- Interpret results of a computation in the light of theory.
- Prove theoretical properties of numerical methods.
- Implement numerical algorithms.
- Describe methods for solving computational problems.
- Apply numerical algorithms to specific problems.
- State theoretical properties of mathematical problems and numerical methods.

Transversal skills

- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

TEACHING METHODS

Ex cathedra lecture, exercises in the classroom and with computer

List of verbes with cognitive level

Higher

Advise, Argue, Assess / Evaluate, Choose [an appropriate method], Compose , Construct, Contextualise, Coordinate, Create, Critique, Decide, Defend, Design, Develop [a rule, model or system], Elaborate, Estimate, Expound, Formalize, Formulate, Generalize, Hypothesize, Infer, Integrate, Interpret, Judge, Justify, Manage, Negotiate, Optimize, Plan, Produce, Promote, Propose, Prove, Sketch, Specify [a role, a function], Structure, Synthesize, Systematize, Theorize, Transpose

Mid-range

Analyze, Anticipate, Apply, Assemble, Carry out, Categorize, Characterize, Check [against criteria], Compare, Compute, Conduct [a study, an experiment], Contrast, Deduce, Demonstrate, Derive, Detect, Differentiate, Dimension, Discriminate, Distinguish, Examine, Exploit, Explore, Implement, Investigate, Make, Manipulate, Model, Modify, Operate, Organize, Perform, Predict, Quantify, Realize, Reason, Report, Search, Solve, Take into consideration, Test, Transcribe, Translate, Use, Verify, Visualize, Work out / Determine

Lower

Arrange, Classify, Complete, Define, Describe, Discuss, Draw, Establish, Explain, Express, Give an example, Identify, Illustrate , Label, Link, List, Match, Order, Present, Quote, Recall, Recognize, Reconstruct, Represent, Respond, Restate, Select appropriately, State

List of transversal skills

Project management

Assess progress against the plan, and adapt the plan as appropriate.

Plan and carry out activities in a way which makes optimal use of available time and other resources.

Set objectives and design an action plan to reach those objectives.

Use a work methodology appropriate to the task.

Working in groups and organisations

Chair a meeting to achieve a particular agenda, maximising participation.

Communicate effectively with professionals from other disciplines.

Communicate effectively, being understood, including across different languages and cultures.

Evaluate one's own performance in the team, receive and respond appropriately to feedback.

Give feedback (critique) in an appropriate fashion.

Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

Keep appropriate documentation for group meetings.

Negotiate effectively within the group.

Resolve conflicts in ways that are productive for the task and the people concerned.

Working in society

Respect relevant legal guidelines and ethical codes for the profession.

Respect the rules of the institution in which you are working.

HUM-432(a) How people learn I	How people learn I	
Lecturers : Tormey Roland John		Language : English
Study plan Humanities and Social Sciences 2014-15	Semester Mand. Option Filières MA1 x	Credits : 3 Number of hours : A week :3h Distribution : Lecture : 2h hebdo Project : 1h hebdo

SUMMARY

The students will understand the range of factors that contribute to adult learning (different abilities, approaches to learning, social contexts and interaction with teachers, motivation and emotion). Students will be able to design a piece of educational research.

CONTENT

Social and Cognitive Factors in Adult Learning
General Aim: To enable participants to understand the learning processes of those of post-school age.
General Description of Material:The ability for individuals and organisations to learn is often regarded as central to their survival and success in the contemporary world. But how do people learn and what are differences in the ways they learn? Learning is partially a psychological concept, but understanding learning also draws on sociology and on the philosophical exploration of what we mean by knowledge (epistemology). Therefore understanding learning will involve a multi-disciplinary approach in order to understand what is happening when people are learning.
Plan of the course:Through exploring a number of types of studies on different aspects of learning, participants will build an understanding of some different research approaches which are used in studying learning. Students will also participate in studies and experiments to give them concrete experiences both of research approaches and of adult learning in practice.

Keywords

Learning, Education, Social and Behavioural Science Research, Interdisciplinary Studies

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Define the concept of learning, highlighting a range of definitions and their implications for the study of learning
- Describe the way in which information is processed and memories formed in humans, referring to Attention, Working Memory, Long Term Memory and related concepts
- Describe the role of individual differences (Intelligences, Personality, Approaches to Learning) in accounting for learning
- Describe the role of motivation, emotion and emotional self-regulation in relation to learning
- Describe the role of micro-social factors (interaction with teachers, peers and others) in accounting for learning
- Identify examples of how macro social factors (social class, policy and institutional factors etc.) impact upon the learning of different social groups
- Apply this knowledge to understand real-life learning situations
- Apply research design principles to design a piece of survey or experimental research
- Integrate psychological and social perspectives in studying learning
- Design a survey or an experiment to study learning

Transversal skills

- Make an oral presentation.
- Communicate effectively with professionals from other disciplines.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Summarize an article or a technical report.

TEACHING METHODS

First semester: lectures; labs;discussion of readings

EXPECTED STUDENT ACTIVITIES

Attendance in lectures and participation in in-lecture discussions; Participation in research labs; Reading of assigned

materials and discussion of readings; Communicating in oral or electronic form

ASSESSMENT METHODS

20% presentation in one of a number of formats (in front of class, on video, electronically)
80% Exam

SUPERVISION

Office hours	Yes
Assistants	No
Forum	Yes
Others	Forum for discussion in Moodle

RESOURCES

Bibliography

- Bransford et al. (2000) *How People Learn: Brain, Mind, Experience and School*. Washington D.C.: National Academy Press.
- Illeris, K. (2009) *Contempory Theories of Learning; learning theorists ... in the own words*. London: Routledge.
- Jarvis, P. et al. (2003) *The Theory and Practice of Learning*, 2nd Edition. London: Routledge.

Ressources en bibliothèque

- How People Learn / Bransford
- Contempory Theories of Learning / Illeris
- The Theory and Practice of Learning / Jarvis

Références suggérées par la bibliothèque

Websites

http://craft.epfl.ch/page-81004-fr.html

Moodle Link

http://moodle.epfl.ch/course/view.php?id=13735

PREREQUISITE FOR

How People Learn II (HUM-432[b])

CREDITS AND WORKLOAD

Credits	3
Total workload	90h
Exam session	Winter
Type of assessment	During the semester

MATH-251(a) Numerical analysis	Numerical analysis	
Lecturers : Ballani Jonas		Language : English
Study plan Génie civil 2014-15 Sciences et ingénierie de l'environnement 2014-15	Semester Mand. Option Filières BA5 x BA5 x	Credits : 3 Number of hours : A week :3h Distribution : Lecture : 2h hebdo Exercises : 1h hebdo

SUMMARY

The student will learn how to solve numerically some relevant mathematical problems. The theoretical properties of these methods will be discussed.

CONTENT

- Stability, condition number and convergence of numerical methods
- Polynomial interpolation and least squares approximation
- Numerical integration
- Direct methods for the solution of linear systems
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- Iterative methods for the solution of eigenvalue problems
- Numerical approximation of ordinary differential equations
- Finite difference approximation of 2-point boundary value problems
- Introduction to MATLAB/OCTAVE

Keywords

numerical algorithms, linear systems, differential equations, Matlab

LEARNING PREQUISITES

Required courses
Analysis, Linear Algebra

Recommended courses
Programming

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose a method for solving a specific problem.
- Assess / Evaluate numerical errors.
- Interpret results of a computation in the light of theory.
- Prove theoretical properties of numerical methods.
- Implement numerical algorithms.
- Describe methods for solving computational problems.
- Apply numerical algorithms to specific problems.
- State theoretical properties of mathematical problems and numerical methods.

Transversal skills

- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

TEACHING METHODS

Ex cathedra lecture, exercises in the classroom and with computer

EXPECTED STUDENT ACTIVITIES

Attendance of lectures.
Completing exercises.

Solving elementary problems on the computer.

ASSESSMENT METHODS

20% written test during the semester
80% final written exam (135 min) during the exam session

RESOURCES

Bibliography

• "Calcul scientifique : cours, exercices corrigés et illustrations en MATLAB et Octave / by Alfio Quarteroni, Paola Gervasio, Fausto Saleri". Year:2010. ISBN:978-88-470-1675-0

• "Méthodes numériques : algorithmes, analyse et applications / Alfio Quarteroni, Riccardo Sacco, Fausto Saleri". Year:2007. ISBN:978-88-470-0496-2

• "Scientific computing with MATLAB and Octave / Alfio Quarteroni, Fausto Saleri, Paola Gervasio". Year:2010. ISBN:978-3-642-12429-7

Ressources en bibliothèque

• Méthodes numéroqies / Quarteroni

• Calcul scientifique / Quarteroni

• Scientifi computing with MATLAB and Octave / Quarteroni

Références suggérées par la bibliothèque

Notes/Handbook

Lecture notes will be provided.

CREDITS AND WORKLOAD

Credits	3
Total workload	90h
Exam session	Winter
Type of assessment	Written

PHYS-458 Metrology I				Metrology I	
Lecturers : Mari Daniele, Tkalcec Iva					Language : English
Study plan	Semester	Mand.	Option	Filières	Credits : 2
Science et génie des matériaux 2014-15	MA1	x			
Science et génie des matériaux 2014-15	MA3	x			Number of hours : A week :2h Distribution : Practical work : 2h hebdo

SUMMARY

This course is a practical introduction to classical measurement techniques in a physics laboratory. The aim is to familiarise the students with data acquisition, sensors, signal processing, vacuum and cryogenics.

CONTENT

I Unit systems and magnitude orders
II Data acquisition and error analysis
III Measurement devices
IV Optical systems
V Vacuum technology, cryogenics

Keywords

electrical circuits, sensors, automatic control, signal processing, analogic signals, digital signal, cryogenics, vacuum, labview

LEARNING PREQUISITES

Important concepts to start the course
concept on electrical circuits, Ohm law, concepts of units, drawing a graph with appropriate scales (linear, logarithmic)
concept of pressure, force, displacement

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Assemble a setup for measuring physical observables
- Sketch graphically the result of a measurement
- Use measurement devices
- Justify the advantage of an experimental setup
- Realize a measure chaine for a sensor
- Illustrate how a sensor works
- Make a calibration

Transversal skills

- Use a work methodology appropriate to the task.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Resolve conflicts in ways that are productive for the task and the people concerned.
- Take responsibility for health and safety of self and others in a working context.
- Collect data.
- Access and evaluate appropriate sources of information.
- Assess progress against the plan, and adapt the plan as appropriate.

TEACHING METHODS

Hands on tutorial classes in groups of 5-6 students working on a bench

EXPECTED STUDENT ACTIVITIES

make the planned experimental setup in the classroom and repeat at home so that the student will be able to reproduce

and explain the setup

ASSESSMENT METHODS

Oral exam with assembling of an experimental setup

SUPERVISION

Office hours	Yes
Assistants	Yes

RESOURCES

Moodle Link
http://site moodle avec toute la documentation du cours, polycopié et présentations
http://moodle.epfl.ch/enrol/index.php?id=13732

PREREQUISITE FOR

Physics laboratory Ib

CREDITS AND WORKLOAD

Credits	2
Total workload	60h
Exam session	Winter
Type of assessment	Oral

CS-322 Introduction to database systems	Introduction to database systems				
Lecturers : Valluri Ramachandra Satyanarayana					Language : English
Study plan	Semester	Mand.	Option	Filières	Credits : 4
Energy management and sustainability 2014-15	MA2		x		
Informatique 2014-15	BA6	x			Number of hours :
Sciences et ingénierie de l'environnement 2014-15	MA2		x	C	A week :4h
Sciences et ingénierie de l'environnement 2014-15	MA4		x	C	
Systèmes de communication 2014-15	BA6		x		Distribution : Lecture : 2h hebdo Exercises : 1h hebdo Project : 1h hebdo

SUMMARY

This course provides a deep understanding of traditional and modern big data management systems. It covers fundamental data management topics such as system architecture, data models, query processing and optimization, database design, storage organization, and transaction management.

CONTENT

This course allows the student to acquire a database specialist/administrator profile, while providing a deep understanding of the entire design of a data management system.

During this course, the students will learn about:

- The Entity-relationship and Relational Models
- Relational Algebra and Calculus
- The SQL Query Language
- Traditional and Modern Data Storage, File Organizations, and Indexing
- Hashing and Sorting
- Query Evaluation and Relational Operators
- Query Optimization
- Schema Refinement
- Transaction Management (Concurrency Control and Recovery)

Homework

Homeworks will be assigned to aid and assess comprehension of the above material. Homework will be either done using pen and paper or they will be programming exercises. During the semester the students will be asked to do a project to gain experience on how to build a database application, and to apply what they learn in class.

Keywords

databases, database design, data modeling, normalization, database management systems (DBMS), files, indexes, storage, external sorting, queries, query evaluation, query optimization, transactions, concurrency, recovery, SQL

LEARNING PREQUISITES

Required courses

Data structures

Recommended courses

For the practical part of the course (project) the following skills will be needed:

- System oriented programming, with focus on scripting languages to enhance the parsing process of raw data.
- Building user interfaces, either web (e.g., PHP, JSP, ASP, ...) or application GUI (e.g., java).

Important concepts to start the course

Before the beginning of the course students must be familiar with:

- Data structures
- Algorithms concepts

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Express application information requirements
- Use a relational DBMS
- Create a database on a relational DBMS
- Design a database with a practical application in mind

- Model the data of an application using ER and relational modeling
- Explore how a DBMS performs its work
- Report performance and possible optimizations for applications using DBMS
- Justify design and implementation choices

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Write a scientific or technical report.
- Make an oral presentation.

TEACHING METHODS

Ex cathedra; including exercises in class, practice with pen and paper or with a computer, and a project

EXPECTED STUDENT ACTIVITIES

During the semester, the students are expected to:

- attend the lectures in order to ask questions and interact with the professor,
- attend the exercises session to solve and discuss exercises abou the recently taught material,
- work on a project during the semester which covers the practical side of building an application using a database system,
- take a midterm
- take a final exam

ASSESSMENT METHODS

Homework, project, written examinations and continuous control.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography
Slides, list of books, additional material (research articles), all indicated and/or available on moodle page.

Notes/Handbook
The slides that are used in the class are available for the students.

Websites
http://dias.epfl.ch/courses
http://moodle.epfl.ch/

Moodle Link
http://moodle.epfl.ch/course/view.php?id=198

PREREQUISITE FOR

Advanced databases

CREDITS AND WORKLOAD

Credits	4
Total workload	120h
Exam session	Summer
Type of assessment	Written