Cátedras Telefónica

ETSIT UPM

Inductive Learning:
A Methodology for Flipped Classrooms and MOOCs

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2013: the First MOOC

- High demand of learning new Web standards
  - HTML5, CSS, Javascript, node.js, …
    - Existing books and courses mainly for professionals
- Spain was changing to Bolonia Curricula
  - "Internet Computing" course being created
    - Based on an HTML/JavaScript and node.js project (PBL - Project Based Learning)
- ComunicaMedia Educational Innovation Project
  - Classroom recording of courses
    - Classroom recordings expected to help in MOOC preparation
- Telefónica looking for a MOOC on FirefoxOS
  - on the Spanish MOOC Platform MiriadaX
    - Agreement signed June 2013 for 5 MOOCs
      - Start of first MOOC on Cliente-side HTML5-CSS-JavaScript on 11-2013

Basic Rule of the MiriadaX MOOC Platform

- Record micro-lectures of between 3 and 12 minutes
  - Evaluate micro-lectures always with a test or a P2P
- Recorded lectures were not reusable!
  - Classroom explanations were not aplicable to MOOCs!
- The slide presentations had to be reorganised in
  - micro-lectures with up to 6-12 slides
    - Micro-lectures evaluated with a test or a simple P2P
  - The restructuring work was huge!
- 5-8 Micro-lectures were grouped in a Module
  - The module was evaluated with a more complex P2P

The Methodology

- First edition: 11-11-2013 a 15-1-2014
  - ~15.000 registered, ~12.500 started and ~2.500 finished
    - ~2.500 persons successfully performed 70 micro-learning-activities!
- Start to flip the classroom: Internet Computing Course
  - Goal: transform all learning materials of the course to support self-learning
    - Using micro-learning-resources
      - Based initially in 4 elements: slides, videos, tests, P2P exercise
- A methodology has been developed: EMIAIL
  - Goal: to improve MOOC and flipped classroom effectiveness
    - Tested in the succeeding MOOC and in-class course editions
      - Client-side MOOC: 7 editions -> 2 (2014), 1 (2015), 2 (2016) and 1 (2017)
      - Server-side MOOC: 1st edition in 2015 (second about to start)
      - Git-GitHub MOOC: 1st edition about to start
- Metaphors applied to the learning process used
  - Inductive reasoning (Empiricism School of Philosophy)
  - Scientific method (For experimental validation of scientific theories)

Inductive vs Deductive Learning

- Inductive Learning
  - Exposes the learner with examples illustrating use cases of a concept or theory
    - The learner must discover or notice the general concept or theory by himself
  - Also known as: learn by examples
  - It is learner centric
    - Motivates and promotes creativity as learners have to discover by themselves
- Deductive Learning
  - Esposes the learner with the general concept and rules of use
    - The learner must practice and apply the general concept in a variety of ways
  - It is teacher centric
    - For highly motivated learners to practice the general concept in a variety of use cases
- Meaningful Learning (D. Ausubel)
  - New knowledge must be related to relevant knowledge already acquired
    - Effective and motivating deductive learning approach
      - Already acquired knowledge is used as a model for the new one to be learned

EMIAIL Methodology

- Exhaustive
- Micro-Illustrated
- Active
- Inductive
- Learning

EMIAIL Learning Micro-Activities

- EMIAIL is a micro-learning approach where
  - The course is composed of a large **sequence of micro-activities**
    - Micro-activities can be grouped in modules or chapters
      - Each micro-activity must be explained in a short video of 3-12 minutes
- Each micro-activity must have a well defined **objective**
  - The learning **micro-objective** defines the learning target
    - Micro-objectives should focus on a unique aspect of the concept or theory
- Each micro-activity must focus on the micro-objective
  - It must **explain**, **illustrate**, **practice** and **validate** the micro-objective
    - With slides, video, exercises, docs, references, tests, P2P, ..
  - The **micro-illustration** must facilitate the understanding and allow exercises
  - The **evaluation** must determine the learner´s progress regarding the objective

Micro-illustrations

- **Micro-illustrations** are good and well focussed examples
  - The example must properly illustrate the micro-objective addressed
    - And **must focus only** in the **micro-objective** addressed
  - Examples can provide also the basis for exercises: modifications, corrections, ..
    - Practical work should be always proposed in a micro-activity
- **Micro-illustrations**
  - Should be designed to facilitate the inductive learning process
    - Some illustrations must focus on particular isolated aspects
    - Other illustrations must focus on integration, generic rules, etc.
  - Illustrations should also relate to already learned parts
    - Meaningful learning (D. Ausubel) is very important
- Development of proper micro-illustrations
  - Takes a large amount of the resources invested in the development of the course

Validation: Tests, P2P, ...

- Validations should be considered also as learning activities
  - Where the learner does additional practical work
    - They must help him to better understand and to consolidate the knowledge acquired
- **Tests** should be thorough revisions of the micro-objective
  - and evaluate the progress at the same time, for example
    - Check a large part of the use cases of the micro-objective, including good and bad ones
    - Check about the implications of a theory or concept
    - Check all the definitions of the main concepts presented in a micro-activity
- **P2P** (Peer to Peer) evaluations
  - Are used for evaluation of more creative and open exercises
    - Where other learners in the course evaluate their peers
  - P2P evaluation should be always considered as a collaborative learning activity
    - Where evaluators and evaluated collaborate in the learning process
- **Automatic test frameworks** in software
  - are very useful in programming courses
    - They provide very good guidance to learners about the progress achieved if well designed

Coverage: the Scientific Method Metaphor

- The Scientific Method Metaphor
  - Is helpful for identifying the set of micro-resources needed
    - Micro-resources must cover all relevant parts of a theory or knowledge
      - Main concepts, typical cases, limit cases, special cases, ...
    - Micro-activities must describe not only the individual components
      - They must target also the combinations, mixtures and complex implications
- The metaphor must be applied somehow backwards
  - The learner must be confronted with all the elements of the theory
    - To properly understand it
- The coverage of the theory or knowledge learned
  - Should be treated somehow like testing in software engineering
    - Where the set of tests and P2P exercises act as the individual tests

Scientific Method (Wikipedia 1st paragraph)

The **scientific** learning **method** is a body of techniques for learning (~~investigating~~) concepts/theories (~~phenomena~~), acquiring new knowledge, or correcting and integrating previous knowledge.[2] To be termed scientific, a method of learning (~~inquiry~~) is commonly based on active (~~empirical~~) or validated (~~measurable~~) evidence subject to specific principles of reasoning.[3] The Oxford Dictionaries Online define the scientific learning method as "a method or procedure (~~that has characterized natural science since the 17th century~~), consisting in systematic practice (~~observation~~), validation (measurement), and micro-learning-activities (~~experiment~~), and the formulation, testing, and modification of micro-learning-objectives (~~hypotheses~~)".[4] Micro-learning-activities (~~Experiments~~) need to be designed to evaluate (~~test~~) micro-learning-objectives (~~hypotheses~~). The most important part of the scientific learning method is the micro-learning-activity (~~experiment~~).[5]

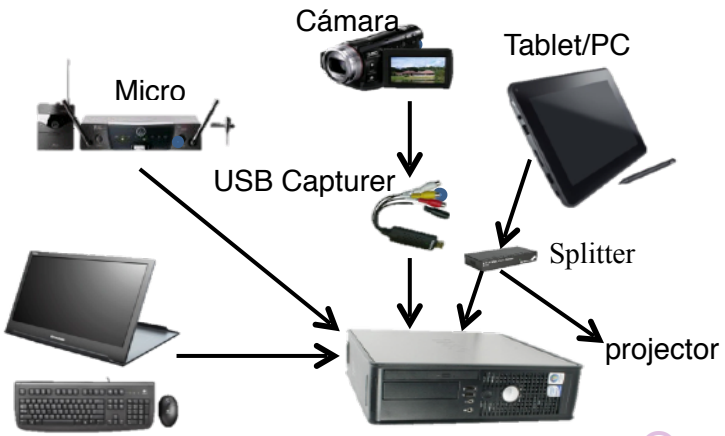
In red text added, in parenthesis (~~text removed~~)

Ordering: the Inductive Reasoning Metaphor

- Metaphor: "small particular observations infer general theories"
  - Adapted to: "small learning-activities infer more general knowledge"
    - micro-resources must start with simple cases before going to general rules or patterns
- The Inductive Reasoning Metaphor
  - Is helpful for defining the ordering of micro-resources
    - And generating the educational workflow
- The definition of the sequence of micro-objectives
  - Is a very difficult task which should be targeted from the beginning
- Project based learning very recommended
  - The alignment of the order with the steps of a real project
    - Helps learners to be constructive, creative and more motivated

The recording studio

- Cheap recording studio was created
  - Equipment under 3000 Euro.
- Needs **no post-production**!
  - Video produced in final shape
    - Recorded image presented to speaker
- Recordings can be repeated
  - With minimal effort



Conclusions

- Multimedia Micro-Resources are extremely powerful
  - They have changed very deeply my view of learning
    - The learning "productivity" or "efficiency" is huge
- A flipped classroom based on MOOCs or equivalents
  - Has a huge potential for universities
- Professor shifts activity to content production
  - In-classroom activity should be more creative and workshop oriented
- MOOCs have a huge outreach
  - Increases very significantly the impact of the work done at the university
    - The will have a deep impact in Universities, especially public ones
- The collaborative learning dimensión in MOOCs
  - Is much more effective than I expected

Thanks & questions