

**An online course to teach ATD research praxeologies: The ICMI Awardees
Multimedia Online Resources**

**Un cours en ligne pour enseigner les praxéologies de recherche ATD: les
ressources multimédias en ligne des lauréats de l'ICMI**

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Résumé

Nous présentons quelques éléments d'un projet de ressource en ligne multimédia adressée à des chercheurs internationaux qui veulent s'initier à la TAD. Le projet a été lancé par le comité exécutif de la International Commission on Mathematical Instruction (ICMI) pour produire un projet pour chaque médailliste Felix Klein et Hans Freudenthal.

Mots-clés: Théorie anthropologique du didactique, ICMI, Transposition didactique, Praxéologie, Parcours d'étude et de recherche, Enseignement par l'investigation.

Abstract

We present some of the main elements of a project of Multimedia Online Resource addressed to international researchers willing to be initiated in the ATD. The project was launched by the executive committee of the International Commission on Mathematical Instruction (ICMI) to produce some material related to each Felix Klein and Hans Freudenthal medals awardees.

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Keywords: Anthropological theory of the didactic, ICMI, didactic transposition, Praxeology, Study and research paths, Enquiry-based teaching.

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The ICMI-AMOR project

The executive committee of the International Commission on Mathematical Instruction (ICMI) has decided during its meeting in June 2015 to launch an operation in order to produce some material related to each Felix Klein and Hans Freudenthal medals awardees. This material will consist in short video, text, interviews, guidelines, etc. that could be incorporated in a Massive Open Online Course (MOOC) that would represent a general overview of the international community in Mathematics education.

Jean-Luc Dorier has been designated by the EC to initiate this project for the three French medallists (Guy Brousseau, Yves Chevallard and Michèle Artigue) and he has proposed Michèle Artigue (Paris), Annie Bessot (Grenoble), Marianna Bosch (Barcelona) and Claire Margolinas (Clermont-Ferrand) to lead this project. The team has decided to realise a 2 hours video made of 10-12 modules of 10 minutes for each awardee, along with some material like texts, but also extracts of class videos and protocols, textbooks, etc., in order to exemplify some ways of making the theoretical tools operational. The three sets of material will be introduced by a unique presentation pointing out some common aspects. This will constitute a core set of material, that would serve as example for the other awardees and it will be accessible in English, French and Spanish, either with subtitles or different versions in each language, depending on the difficulty of translation.

Moreover, on top of this work and as a second step in the project, the team has decided to prepare an extended proposal for each medallist, mostly in French, that will develop the issues raised in the first level and will give more opportunity to the students to try some theoretical and methodological tools through various examples.

We are here presenting the proposal – still in process – of the course on ATD, for its discussion among the ATD community. One of the main resources used in its preparation is an invited conference given by Yves Chevallard in Osaka (Japan) in October 2016 where he presented the principles and use of the ATD to a public that was not familiar with this approach and, thus, corresponds to the once considered in the ICMI – AMOR project.

Overview of the course

The course is organised according to what can be considered as two general learning strategies. The first one, more traditional, strongly relies on Yves Chevallard's lecture notes and reproduces the lecture structure, centred on four ATD “sub-theories”: the theory of didactic transposition, personal and institutional relationships, praxeologies and the ecology of the didactic (modules 2-5). In each module, the student will be faced with an initial question related to each sub-theory and some empirical and methodological elements will be introduced to elaborate some pieces of answers. We can relate it to a *study and research activity* (SRA) focused on a previously established ATD-research praxeology.

The second part of the course addresses the more recent developments of the ATD to approach the transition from the “visiting works” to the “questioning the world” paradigms. The strategy adopted here corresponds more to the spirit of *study and research paths* (SRP). An initial question is formulated: Why is there such a sudden and strong interest in teaching inquiry-based activities at school? How to address this problem? The student is then invited to follow a team of researchers in their specific way of approaching this question. Some elements of the researchers' praxeologies will be explicitly described, while others will only be shown in vivo.

The provisional titles of each module can help get a first overview of the course:

Introduction

1. Yves Chevallard and the anthropological theory of the didactic

Lecture study

2. The didactic transposition theory
3. Personal and institutional relationships
4. Praxeologies
5. The ecology of the didactic

The ATD at work

6. Initial question, units of analysis, institutions
7. Research methods and didactic engineering
8. A study and research path on forecasting Facebook user growth
9. *A priori* analysis: Herbartian schema and dialectics
10. *In vivo* and *a posteriori* analysis: chronogenesis
11. *In vivo* and *a posteriori* analysis: mesogenesis and topogenesis
12. Ecological analysis and open questions

Some elements of the “lecture study” modules

Module 2 takes as initial question the teaching of proportionality. The process of didactic transposition is introduced together with a mention of the enlargement of the unit of analysis associated to each question. The teacher usually assumes the knowledge to be taught as a given and focuses on the design and implementation of teaching and learning activities. This is not the perspective of the ATD researcher, who starts by questioning the nature and origin of the knowledge to be taught. Some new theoretical elements need to be introduced to name and describe the entities that appear in this process – the noosphere and the scholarly knowledge – and the kind of constraints they impose on the knowledge to be taught.

Proportionality is a good example of the construction and evolution of a strong mathematical organisation that has been part of the mathematics to be taught during a long period: the theory of ratio and proportions and the rule(s) of three. With this case, various aspects of the didactic transposition process can be illustrated with some empirical data easy to consult. The evolution of the scholarly knowledge can be seen through productions of mathematicians of the “classic era” like Newton or Euler, the

disappearing of the classic organisation in today's mathematics but not in today's sciences). The productions of the noosphere can be mainly approached through educators' discourses about the importance of proportional reasoning and the contents of some teacher education courses. Finally, the evolutions of the knowledge to be taught can be made visible through some examples of textbooks from different periods: classic books including the theory of ratios and proportions, New Maths books without any trace of it, modern or current textbooks with a mixture of pieces from the old and the new mathematical organisations.

This module does not provide a full analysis of the didactic transposition phenomena affecting proportionality. It only introduces the main tools for the analysis and provide a selection of evidence that can help the student address some of the questions that will be left open.

A similar strategy is used with the module on institutional and personal relationships. The case study selected here is the teaching of fractions and the empirical evidence provided is made of the productions of students showing personal idiosyncrasies in their way of solving an arithmetical problem. This differences in the personal relationships to fractions can be explained by the students' nationality and the way fractions are taught in the educational system of their country: the institutional relationships that contribute to shape the personal relationships.

In the module about praxeologies, the classic organisation of ratio and proportions is again taken as an example. The stability of this construction make it easy to illustrate the notions of types of tasks, techniques, technologies and theories. It also shows, by contrast, the lack of elaborated technological discourses in today's mathematics and, more importantly, the difficulties created by an unstable school theoretical treatment of quantities.

Finally, the module on the ecology of didactic – still in preparation – will take as an example the case of school algebra to illustrate the various constraints coming from the different levels of didactic codetermination, using the examples developed in Bosch (2015).

The “ATD at work” modules

The last set of modules aim at reproducing a true research process carry out by a team of researchers around the question of inquiry based learning and the notion of *study and research path*. We adopt the strategy followed in what we call “study and research paths for teacher education” (Ruiz-Olarría 2015). The course starts with a teacher initial question and its first approaches from different institutional perspectives. Empirical elements taken from the experimentation of a *study and research paths* implemented in a first year university course are provided to support the analyses of inquiry activities using the Herbartian schema and the different study dialectics. It is also used to address the question of the ecology of this new type of activities and the new epistemological, didactic and pedagogical needs that are raised in the evolution from the paradigm of visiting works to the paradigm of questioning the world.

The dissemination of the ATD

Many of the elements used in the modules have been already experienced in different talks, seminars or research courses in different countries and with different types of audiences. However, their adaptation to a fully online course still remains a big challenge for us. We all have different experiences as “ATD students” and may know about better ways of making some of the main notions and methodologies available to others. Some of us also have some experiences as “ATD teachers” (or just study helpers) that can bring about new insight. We therefore welcome any suggestion, comment or criticism from the ATD research community.

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