Inquiry based learning and their declensions in mathematics, physics and earth sciences

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Summary of articles

JEAN-YVES CARIOU
What criteria for what kind of inquiry-based learning? Learners as active students, actors, authors?

The international promotion of inquiry-based learning and the approaches under this common banner in France, in experimental science, technology and mathematics, question the very meaning of the term, as well as its unity and diversity. Any activity performed by learners seems to qualify for an inquiry, simply because the students are active or actors. However, the promotion of inquiry has a deeper meaning, which transpires in its origins: epistemological, psychological and educational considerations have historically contributed to advocate an approach in which the essential elements of the research spirit could be implemented in the classroom. Attempts to define and characterize inquiry have been made, but not always with an emphasis on those fundamental principles. Referring to the considerations emanating from those various fields allows to bring these principles back to foreground, to pay attention to their being mentioned in speeches about inquiry, and to consider the criteria along which they may be implemented in natural sciences, mathematics and technology classes.

MARYLINE COQUIDE & ESTELLE FLATTER
From design of Inquiry based teaching to its implementation. A case study in biology teaching at middle school.

To contribute to better knowledge of the factors that influence the workings and implementations of inquiry based teaching, we propose a case study of four biology teachers at middle school. Preliminary interviews were conducted, class sessions were recorded and stimulated records (Clot 2001) were made. The analyses of the corpus show representations of the investigations, on the roles of the teacher and of students. The interviews show the importance of curricular aspects, concerning the content and resources, material resources, time constraints and pedagogical aspects. Two specific analysis on the balance between guidance by the teacher and student autonomy on the one hand, the link between teachers establish investigative approaches and complex tasks on the other hand, are used to study the influence of national and regional curricula.

LUZ HELENA MARTINEZ BARRERA, CECILE DE HOSSON, NICOLAS DECAMP
Constructing of a problem as a first step of science inquiry. Analysis of an in-service training session for primary school teachers in France and Colombia.

Science teaching has undergone significant transformations in terms of pedagogical orientation. These transformations reflect the evolution of an international framework highlighting more open procedures based on "inquiry". In this context, both French and Colombian science curricula require teachers to create problems leading to the implementation of inquiry-based science teaching sequences. Teachers must also motivate students to participate more actively in the process of the scientific knowledge construction. Consequently, helping teachers in the task of designing a problem appears as an essential step for inquiry-based science education to be implemented. In this research, we focus on what favors the construction of scientific problems. We designed an in-
service training session for primary school teachers who have no prior specialization in scientific fields. This training session leans on the use of a scientific topic (the bouncing of the balls) that rarely appears in primary school science curricula. The training session is evaluated through the analysis of the teachers’ interactions within the "problematization" theoretical framework. This allows to understand which elements inhibit or favor the emergence of problems allowing (1) science inquiry (2) the construction of knowledge associated with the phenomenon of bouncing (influence of physical parameters, construction of characteristic scales, etc.).

MICHELE GANDIT

Formative assessment and IBSE: examples in mathematic classes

This text presents the beginning of a research project (EvaCoDice) that tries to develop formative assessment in Inquiry-Based Science Education. It is about mathematics. The EvaCoDice project is included in a network of collaborative settings in France and is part of a European project – ASSIST-ME – about assessment within science education. The question is about how the teachers use assessment to help students (10–11 years old) do science. We try modelling scientific practice of the students. Formative assessment requires a change in how teachers see the process of learning and their role within it. We show some difficulties: the teachers cannot use assessment to help students, they are not still ready. We show what kind of skills and knowledge are required on the part of these teachers. A first kind of data results from an analysis of five videos. These videos were realized in classes.

GHISLAINE GUEUDET & MARIE-PIERRE LEBAUD

Use of technology and inquiry in mathematics: which didactic contracts?

Mathematics didactics invites to consider inquiry-based teaching as a particular form of didactic contract, leaving an important responsibility to the students, regarding the knowledge at stake and its evolution in class. Does the use of technology support the development of such a contract? Under which conditions, concerning the mathematical situations, or the role of the teacher, or the use of technology? In this article, we discuss these questions, drawing on the literature, and on different research projects concerning mathematics at secondary school. We analyze the contract, considering how the teacher and the students share the responsibility concerning three dimensions: posing initial questions, producing answers, advancing knowledge.

MAGALI HERSANT & DENISE ORANGE-RAVACHOL

Inquiry based learning in mathematics and earth science education: from issues dividing to reasons for union

In France, the recent curricula for mathematics, science and technology promote primary and middle school students’ engagement in investigative approaches. These approaches are supposed to contribute to the internalization of common skills. How is it possible for the same approach to unite both mathematics and science? Our paper shows that the differences between these disciplines stressed by the institution (experimentation, validation methods) are problematic. It also studies the possibility to combine these fields by considering the construction of knowledge they operate as problematizations.

ALAIN JAMEAU & JEAN-MARIE BOILEVIN

Determinants of construction and implementation of inquiry based science education with two teachers of physics and chemistry at middle school

This paper examines the determinants of teacher’s action during the construction and implementation of an inquiry-based science education (IBSE). We study the case of two teachers, in the context of the teaching of mechanics in grade 9 in France. Our theoretical approach refers to science education and professional didactics. We have developed a specific methodology which one of the principles is monitoring teachers for two consecutive years, which includes their activity outside the classroom. We identify the determinants by analyzing the goals of teachers during their activity and the resulting tasks for students. We rely for this on a tracking criteria used by teachers to build an inquiry-based sequence. We show that different elements involved in the determinants of action: some categories of professional knowledge including PCK but also knowledge of teachers on how students learn science, the history of learning built in a class, on the epistemology of the discipline taught.
CORINNE MARLOT & LUODVIC MORGE
A case study of the role played by doxic professional norms in implementing inquiry-based science education in a nursery school

A study of the literature shows that teachers find it extremely difficult to implement inquiry-based experimental science education. The reasons for this are generally thought in the individual characteristics of the teachers themselves: their epistemological beliefs, the way they relate to their subject, or the insufficiently sound subject knowledge. In this paper, we shall explore another avenue, namely doxic professional norms. It would seem that these norms are shared by teachers, and are rooted in principles coming from primary (national curriculum and guidelines) and secondary (training and school textbooks) instructions. It is this that gives them their legitimacy. We shall begin by a hypothetical formulation of these norms, so that these can then be used in order to analyse and interpret the difficulties a nursery school teacher has in implementing inquiry-based science education. Finally, we shall discuss how these norms can be taken into account in teacher training, and what research still needs to be done in order to confirm the existence of these norms, and the role they play in determining teacher activity.

FRANCESCA MORSELLI, ELISABETTA PANUCCI, MONICA TESTERA
Investigation and explanation activities in lower secondary school

We present a special case of inquiry based learning implemented in Italy in lower secondary school, the «Investigation and explanation activities». At first we present the theoretical framework for the planning and implementation of the activities: the functions of explanation and the construct of rational behaviour. Afterwards, we present and analyze (by means of the theoretical tools) some episodes from a teaching experiment on isoperimetric rectangles. With this article we aim at contributing to the debate on inquiry based learning. More specifically, we tackle two crucial issues: how to characterize the tasks and questions to be posed during inquiry based learning activities; how to characterize the roles of teachers, students and researchers.

FLORIANE WOZNIAK
The inquiry-based method as seen from the anthropological theory of the didactic: the study and research path

We consider that the inquiry-based method is a praxeology for answering a question. The didactic process named the dialectic of media and milieus provides the materials for producing an answer. The Herbartian schema describes the pedagogy of inquiry applied to a study and research path. We suggest that the Herbartian schema could be an epistemic model for the inquiry-based method. We show how this model can provide some conditions concerning mesogenesis, chronogenesis and topogenesis for a real use of inquiry-based method.

Varia

SABINE COSTE
New professionalism of physical education teachers in vocational school. Good distance, sequencing and externalizing rules of academic work

The vocational school is a teaching changing space. Teachers live reforms that challenge the business including the renovation of the certification. Our research focuses on a group of teachers, physical education and sports teachers who have to implement new forms of certification. We study the teacher professionalism through a comparative approach of two groups of professors, teachers already practicing and teachers entering the profession and discovering a learning environment to which they paid little attention during their initial training. Reform of the interim course evaluation, requiring the construction of a new device evaluation and new scoring rules, has become for us a lever to access to the work of teachers. Our analysis allowed us to highlight revealing elements of a “new job” mobilized by teachers entering the profession, the most significant are presented in this article. Thus the construction of the “right distance”, strengthening the sequencing and externalizing rules schoolwork characterizes how to work as “new teachers” to teach with students who are relearning academic standards.
SYLVIE DOZOLME & LUC RIA

New job: teaching in the 2nd degree – Professional changes stories

In France, nearly 20 % of secondary school teachers have had professional work experience outside the educational system. Who are they? Why did they choose to become teachers? This study focuses on the transition faced by these future teachers as they change profession. Coming from a wide range of different professions (warehouseman, secretary, nurse, engineer, salesman...), they undergo a fairly radical adjustment period. The research protocol was developed to analyze the impact of their previous professional experience on their approach to teaching and to document the steps they take and their feelings as they live a process of acculturation. This work should then help us understand not only how acculturation takes place but also how professional people experience their entry into a new job field. It will also shed light on common elements of experience during the period of adjustment to a new profession.

YOLANDE PEIGNÉ

Neither good nor bad. The middel-range pupil experiencing reading and writing in Primary School

While learning the written language, middle-range pupils call out my attention as an experienced school teacher. As a matter of fact, these neither good nor bad pupils with fluctuating results go unnoticed by their teachers throughout the Primary School years. Will they not swell up/increase the statistics of the poor reading/writing results of the Citizenship Day Defense or coming out of Highschool ? Middle-range pupils are those, aged between 7 and 10, who obtain 24 to 36 correct answers out of 60 for the 2009 and 2012 National Assessments are available : interviews with teachers (for pupils aged 8 and 11 years old) ; studying the national assessments results using a systemic and development of their reasoning. The results go beyond the model and lead me to study further way in the path of working memory and skills.

SÉBASTIEN URBANSKI

Teaching About Religions : a Survey in Three Middle-Schools

The article presents the results of a survey which aims to investigate teachers' opinion about the ministerial project of “teaching religious fact(s)”. A short quantitative part puts forward some exploratory hypotheses about a possible influence of religious belief and seniority on the expressed viewpoints. A qualitative part identifies some controversial subjects, for instance: what is cultural and what is collective in the religious fact? Is the teaching of religious fact(s) in itself a means of education to tolerance? More generally, the article shows that there remains some opposition to the ministerial project. This raises the question of the effective implementation of curriculum.

OMAR ZANNA

Learning empathy at school through the body : a new project

These last ten years have seen a real revival of interest for the concept of empathy; it seeks to provide new insights into the logic of understanding and action in social relations. This theoretical work in progress has begun to produce results in sociological research, the psychology of training and the science of education. The experiment combining research, action, and intervention, entitled “Empathy as a means of fighting harassment at school”, and carried out with 9-11 year-old pupils during the 2012-14 school years is a new illustration of it. This project aims at awakening empathy in pupils by physically placing them in situations devised to make them aware of others through their coming to terms with the emotions aroused. The following lines are intended to explain the genesis of the experiment and to give an account of the process and some of the results.