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Patrice Venturini

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## TEACHER'S DIFFICULTIES IN COPING WITH THE TRANSITION FROM STUDENTS' VIEWPOINTS TO AN AUTHORITATIVE STANDPOINT: CASE STUDY CONCERNING THE PRINCIPLE OF INERTIA.

Patrice Venturini

### Abstract

This presentation aims at describing how an experienced teacher copes with the transition from students' viewpoints to an authoritative standpoint when teaching the principle of inertia in a French secondary school (grade 10). In order to describe the teacher's actions, this case study is based on the joint action theory in didactics (Sensevy, 2012) and on the analysis of classroom video data. The results show that the students took the floor to defend their opinion about the mechanical actions exerted on a moving ice-skater. They also point out the teacher's difficulties in having the students accept the teacher's proposals leading to the principle of inertia: the transition from the students' viewpoints to the teacher's authoritative standpoint, made under strong teacher's incitements, is either abrupt or based on ambiguous arguments. This can be related to the nature of the given starting situation that mixes reality and modelling levels without the teacher (and the students) being aware of it, and therefore to the teacher's viewpoint on the nature of science.

Keywords : video analysis ; physics education ; nature of science ;

### Introduction and rationale of the research

The present curricula give importance to students and to situations that enable them to participate to the building of their knowledge. In this context, students are led to express their viewpoints. The teacher then has to support students to adopt scientific views. These two aspects (situations enabling participation in the building of knowledge and changing from personal viewpoints to a scientific standpoint) are difficult to manage for a teacher who still worked a few months ago within a transmissive paradigm. An experienced teacher who wished to teach more in conformity with the curriculum requested us to examine how she dealt with these aspects. The presentation aims at describing how this teacher copes with the transition from students' viewpoints to an authoritative standpoint after giving authority to her students. It is a study case concerning the teaching of the principle of inertia in a French secondary school (grade 10).

### Theoretical framework

Our work was conducted within the Joint Action Theory in Didactics (Sensevy, 2012). The theory attempts to model the human transactions concerning the transmission of a socio-historically built culture. It models the didactic interactions between the teacher and the learner as an organically cooperative learning "game", a joint game within a joint action. To describe the learning game as it occurs in situ with regard to a particular piece of knowledge, the researcher can use a set of specific descriptors, a part of which are described.

The didactic milieu is everything that acts on the student and the teacher, and everything that the student and the teacher act on. It includes conceptual and material elements and evolves continually under the teacher's and students' combined actions. This set of evolving events constitutes the mesogenesis, i.e. the genesis of the milieu. The didactic contract governs the transactions and is considered as a set of often implicit norms or rules that can be seen as a system of expectations and attribution of expectations related to knowledge, between the teacher and the students. When the game is played, the teacher intervenes in different ways. In particular, he/she must devolve the game in order

that the students accept to play it on their own and to establish a relation that is as appropriate as possible to the milieu (devolution). As the students do not immediately play the game using a pertinent strategy, the teacher must intervene to modify their behaviour in order for it to become more relevant to winning the learning game (regulation).

According to the JATD, the teacher's action is determined by his or her subject matter knowledge, by the different institutions she or he is governed by, and by his or her "practical epistemology", that is to say, by his or her more or less implicit theories on the nature of the knowledge taught, on teaching and on learning physics. It is practical because it acts on the everyday functioning of the class and because it is in large part produced by practice.

## **Methodology**

To answer the research question, the video recording of the lesson constituted the main data, complemented by the worksheet the students had completed. The interactions and the significant gestures were transcribed. The second step of the methodology gave a first description and understanding of the lesson that was threefold and comprised: 1) an a priori epistemological analysis of the tasks set in order to identify the possible variants of the lesson; 2) the structuring of the lesson according to the social organization of the class, the theme and subthemes in question, and the different learning games; 3) the formalization of the didactic plot, made up by the significant events considering the transmission of knowledge. The last step of the methodology dealt with the analysis of each learning game, based on its constitutive episodes and using the JATD descriptors.

## **The lesson**

The students first had to complete a worksheet individually (formative assessment). The questions concerned an ice-skater at rest and the same skater moving freely on an iced track. Her position has been regularly recorded by a camera, showing a uniform rectilinear motion. The students had to determine the actions exerted on the skater and to represent them by vectors. Then, the teacher and the students collectively corrected the answers and debated to infer the principle of inertia from them. Concerning the ice-skater in motion, the teacher expected the students to consider only the action of the Earth and the reaction of the track, in order to consider that the forces exerted on the skater were balanced, as they were when the skater was at rest. The a priori analysis of the task lead us to consider that the students had to model the actions exerted on the ice-skater so that they fit her already modeled uniform rectilinear motion, without never speaking of models. As the students resolutely proposed to consider the action of the air, the friction of the track, and a "driving-force" exerted by the skater on herself, the teacher had to act in order that they adopt her point of view.

## **Findings**

We can say that the teacher succeeded in devolving the work to the students. They regularly took the floor and were engaged in solving the questions throughout the lesson. This successful process can be related to the status of formative assessment given to these questions and also to some of the perennial dimensions of the didactic contract because the students seemed to be used working in such a way. On the other hand, the teacher had many difficulties to achieve the elimination of the skater's driving force. She regulated the corresponding learning games using successively a scientific argument, namely a system does not act on itself, a formal argument linked to the wording of the question and finally an argument of authority related to the possibility to continue the lesson after the end of the hour. The elimination of the friction of the track took much time and was temporarily achieved when the teacher appealed to the students' daily intuitive experience: if there is friction, this must slow down the skater; as the motion is uniform, there is no friction. This conclusion could also be considered as resulting from the use of the principle of inertia that will be the outcome of the lesson. Moreover, if in the two cases the teacher had a predominant role in the mesogenesis, this was not really efficient: the progress of knowledge was stopped several times, and following excerpts show that many students had not been convinced at all.

## Conclusion

These excerpts show that the transition from the students' viewpoints to the teacher's authoritative standpoint is either abrupt, or based on ambiguous arguments. If this experienced teacher succeeded in giving room to the students' points of view as required by the curriculum, she lacked the means to implement a smooth transition toward the authoritative standpoint.

Likely, the epistemological dimension of her practical epistemology (i.e. her viewpoint on models and reality inferred from her practice) did not help her to plan a relevant starting milieu to work on the inertia principle and to conduct the transition towards the authoritative standpoint: the combination of modeling and reality levels in the same situation (cf. a priori analysis) constituted an obstacle too difficult to deal with. This implies a need to consider the existence of reality and modelling levels as a "theoretical principle" to design physics lessons.

Sensevy, G. (2012). *About the Joint Action Theory in Didactics*. *Zeitschrift für Erziehungswissenschaft*, 2(11). DOI 10.1007/s11618-012-0305-9