SPORT MOVEMENTS, A MOTIVATING THEME FOR TEENAGERS IN A FIRST APPROACH TO ENGINEERING

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INTRODUCTION: Sport biomechanics is a perfect representation of what is a transdisciplinary discipline. This discipline makes indeed use of knowledge in mathematics, physics, biology, and of course, sports. This transdisciplinary nature has pros and cons in terms of education: Pros because sport movement analysis can motivate students or pupils and make them unconsciously use concepts and theory from other disciplines; cons because lacks in some disciplines -typically mathematics- can provoke a mental block in students.
In a first part of this applied session, a special education program developed in order to cultivate the taste of teenagers for sciences through the analysis of their own sport movement will be presented.
In a second part, the approach used in the biomechanics classes of the Faculty of Sport Sciences of the University of Poitiers to introduce the different scientific theories and concepts taking into account the heterogeneity in the physical education students' initial formation will be exposed.

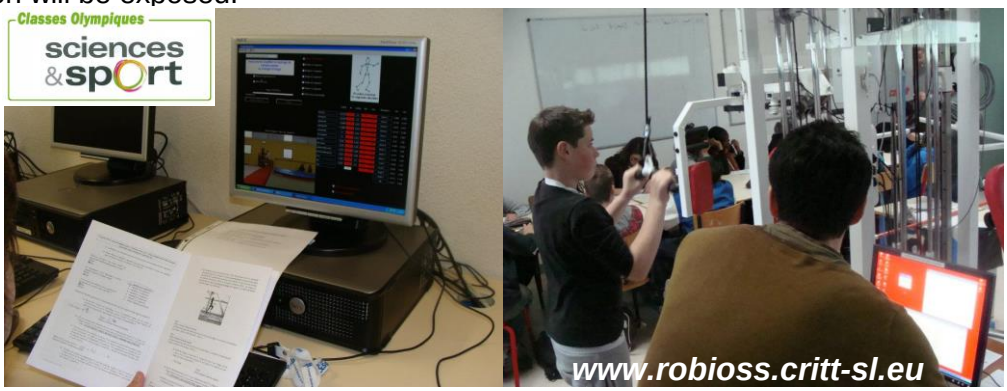

Figure 1: "Olympic Sciences and Sports Classes".

SHORT SUMMARY: On one hand, one can notice in France an important disaffection of the teenagers for the scientific disciplines. This disaffection translates a problem of image, a caution or even a reluctance towards technological progresses. In spite of many efforts, the sciences are still not a part of the general common culture of the teenagers, and this, mainly, because of the absence of a media adequately meaningful for them. On the other hand, physical and sport activities are a social practice especially esteemed and mediatized.
In the school system, Physical and Sport Education is the only subject taught in all the classes, from the primary school to the high school. Despite this, the students – and the professors- consider Physical and Sport Education as a distinct discipline, both by its objectives and its contents, and without relations with the other taught disciplines.
The "Olympic Science and Sport Classes" (Figure 1) is a unique program developed by the Educative Engineering Department of the CRITT "Sport-Leisure" (Regional Centre for Innovation and Technology Transfer in Sports and Leisure) and the biomechanics laboratory RoBioSS of the PPRIME Institute. The aim of this program is to capitalize on the natural curiosity of children to answer a few crucial goals: renovate the teaching of basic concepts in mechanics; to present applied mathematics as an indispensable language between scientists; to demystify modern technologies of computing and communication.

During these classes, the children can measure their own movement thanks to specific tools especially developed. The modeling of the human body as rigid linked segments enables also to introduce different mechanical theories. The teenagers can then scientifically analyze their own athletic productions by comparing their results with their feelings and intuitive explanations but also with the best athletes' results. Sport analysis is then a mean to make teenagers use different theories and concepts from diverse disciplines such as mathematics, physics, or biology. Children enjoy then themselves in several scientific analyzes of practices particularly motivating for them: their own sports performance.

The second part of this applied session would be consecrated to the presentation of the practical works proposed to the sport science students of the University of Poitiers. This second part will then take place in the classroom of the Faculty of Sport Sciences dedicated to these practical works.
The heterogeneity in the students' initial formation makes particularly challenging teaching of biomechanics. The mathematical bases required to understand easily and quickly biomechanics are indeed not always acquired by the students. Moreover, the recent technological developments have the tendency to reduce the students' ability to compute, have in mind all the different processes behind a result or even think on their own.
The practical works proposed at the University of Poitiers have then different purposes:

- To make the student understand and practice basics mathematical operations (manipulation of vectors, computation of integrals/derivatives)
- To introduce the biomechanical concepts
- To develop the students' capacity for analyzing a sport activity

During the first two years, the choice is made to use basic tools and technology in order for the students to well understand all the constraints linked to measure and analyze sport movement such as: the modeling of the human body as rigid linked segments, calibrating cameras for 2D/3D motion capture etc.
For that purpose, specific softwares have been internally developed such as the ANAIS software illustrated on Figure 2. This software enables video capture, manual trajectory identification, treating, and exporting kinematics data. As a complement, simulation softwares are developed in order for the students to better understand the influence of parameters on the performance.
To illustrate this approach and to present the different softwares, a typical practical work session will be presented.

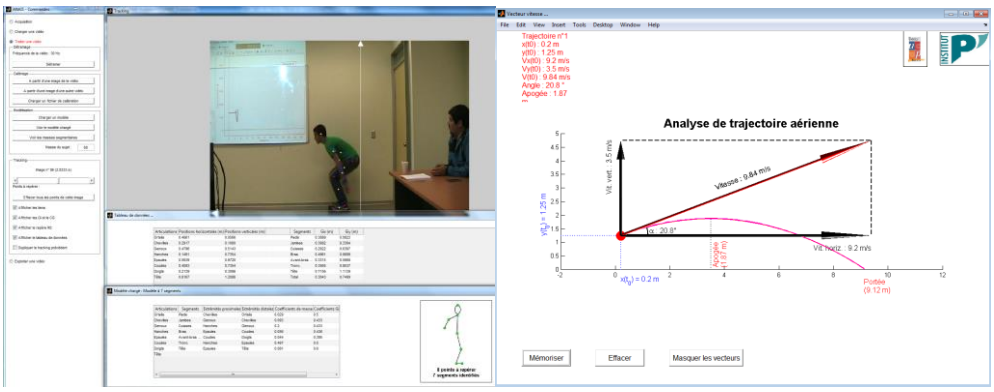

Figure 2: GUI of the ANAIS software and of the simulation software of aerial trajectories.

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