

## Sounds and noises: similarities and differences

Montse Novell

*Group of Innovation in Physics Education. Universitat Politècnica de Catalunya*

*montse.novell@upc.es*

### Abstract

*Very often Physics students get the impression that the reality they see and the one they measure, even in the lab, is just a draft version of what is considered as the real world, which for sure is the world where laws and models work. Observation of complex but real situations is not allowed until students are skilled in the use of suitable mathematical tools. One example is the meaning of 'wave spectrum' which is generally introduced as a result of the Fourier Theorem. This paper shows a multimedia unit prototype, accessible through the web, with the aim of enhancing the learning of similarities and differences between sounds and noises. The unit is based on a particular tool, the hear&see tool, designed to explore the meaning of wave spectrum*

### Introduction

Usually in Physics courses each unit starts by showing simple examples of real life and then tries to construct a model for them, outlining the corresponding laws. After that, we seem to forget the surrounding reality and the model is presented as the relevant matter. As a consequence of that, students get the impression that the reality they see and the one that they measure, even in the lab, is just a draft version of what they consider the real world, which for sure is the world where laws and models work. Observation of complex, but real situations is not allowed until students are skilled in the use of suitable mathematical tools. Only then will they be capable of using the models and therefore explore real situations. It has been demonstrated that this way of learning science creates profound misunderstandings of key concepts and generates a problem of 'inert knowledge' [1]. The unit presented here is based on the use of multimedia and communication technologies to enhance a more effective way of learning. It is designed to be used as complementary resource in High School Physics courses. Students will use them at home or at school, coinciding with classroom lectures.

### 1 Multimedia unit

We seem to have superseded the time when the introduction of multimedia resources was presented along with a list of benefits: increased efficiency, increased student motivation, facilitation of experiential learning

and others [2]. In the case of Physics, multimedia can provide resources for learning most of the contents, however, they can also disturb the learning process by shifting the attention from the reality to the model, in this case to the multimedia product or program. We must be aware of this if we are really convinced that learning is a knowledge construction process.

#### 1.1 Learning goal

The unit learning goal is to identify the features of sound waves and establish some criteria to distinguish between sounds and noises. The central point will be to deal with the meaning of wave spectrum. Usually in Physics teaching the wave spectrum concept is studied in advanced courses, where it is introduced as a result of Fourier Theorem. Then the meaning of 'spectrum' is directly a consequence of a complex integral theorem, rather than an intuitive concept. However, we are used to seeing sound waves spectrums in our high fidelity equalizer display, at home or in the car. Our own sound wave sensor: hearing, allows us to distinguish loud sounds from treble sounds, and even more complex sounds. Wave spectrum is the reality, not the mathematical model which explains it.

#### 1.2 Media used in the unit.

Besides text, in science content it is essential to use equations written in a standardized algebraic way, images can be used to show some instrumentation and sound files, which will be the suitable media to explore sound phenomena. Referring to sound files, the program offers a list of sound files which is not closed, on the contrary, students can increase the list of sound files available by adding their own sound files which they can record using a computer microphone. To deal with the sound waves and their spectrum, the unit uses a specific 'hear&see tool'. This tool is a program that uploads a sound file previously selected and then plays the sound that can be listened to through the computer speakers at the same time as showing the wave and its spectrum. In Fig. 1 a diagram is shown of this tool. The images of wave and spectrum that appear in this diagram and in the presentation of the program have been captured in the display of a real sound sensor. They show the picture of wave and spectrum in a specified instant of time, thus the hear&see tool will work as a real time sensor, showing the time evolution of wave and spectrum at the same time the sound is played.

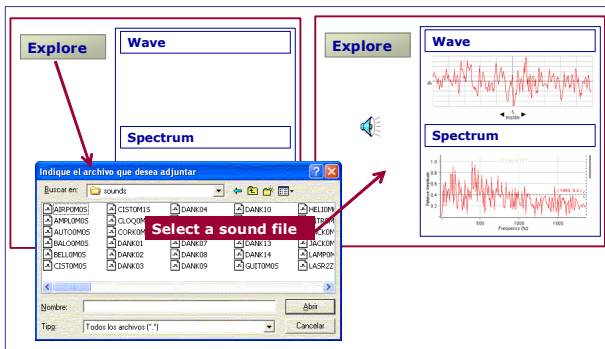


Figure 1. The hear&see tool

### 1.3 Contents structure.

The structure is presented in Fig. 2. There are different kind of ingredients, which are represented by boxes, and the arrows mean that these ingredients are not designed to be used exclusively in one specified unit for one activity or task; on the contrary, they can be shared and can be used in different contexts.

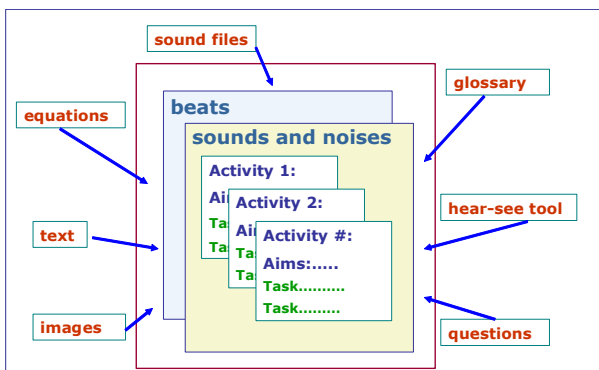


Fig. 2. Multimedia structure

The multimedia units are designed to assemble small entities (equations, sounds, texts, simulations...), and these entities can be used in different learning activities, they are a sort of reusable learning objects [3][4]. The learning activities will be organized in a sort of spiral curriculum. That means that complex topics are introduced in several phases that build on each other [5].

### 1.4 Model of learning.

In higher education institutions, education is mostly based on an objectivist tradition, which says that the world is completely and correctly structured in terms of entities, properties, and relations, that is 'experience plays no role in the structuring of the world; meaning is something that exists in the world quite aside from experience' [6]. It is difficult to forget our objectivist tradition, we must be aware of this in the tasks design to adopt what has been known as a constructivist 'beyond the information given' (BIG) approach [1].

The hear&see tool is based on interaction, however, as Durbridge says [7] there is an overuse of the terminus interaction, without saying what it mean, interaction is understood as a 'good thing' for computer based learning materials. Glancing at the varieties of multimediated materials that he points out, one would say that this project allows for interchange and interrogation. Intercommunication with others and teacher's intervention is not a feature included in the program itself, but it is fostered by using the program in groups and as support material for classroom lectures. The idea is that those multimedia materials will be mainly accessible through the web, in this case a forum/chat tool can be implemented in order to do online discussions when the task requires it.

### Conclusions

The incorporation of Information Technologies in science education gives us the opportunity to introduce changes and break down the objectivist tradition in science education by adopting a constructivist approach for learning. The learning will improve when learning activities are based on tasks to encourage learners to work through the successive phases of the learning cycle, using computers, Internet, www, and multimedia materials as educational resources.

### Acknowledgements

The authors would like to thank Direction General de Investigation of the Ministerio de Ciencia y Tecnologia for financial support (ref: SEC2002-04254-C02-01)

### References

- [1] PERKINS, D.N. Technology meets constructivism: Do they make a marriage?. *Educational Technology*. 1991. vol. 31, num. 5, pp. 18-23.
- [2] DAVIES, M.L. CROWTHER, D.E.A. 'The benefits of using multimedia in higher education: myths and realities'. *Active Learning*. 1995. vol. 3.
- [3] BOYLE, T. Design principles for authoring dynamic, reusable learning objects. *Australian Journal of Educational Technology*. 2003. vol. 19, no. 1, pp. 46-58.
- [4] POLSANI P.R. Use and abuse of reusable learning objects. *Journal of Digital Information*. 2003. vol. 3, num. 4.
- [5] BOYLE, T. *Design for Multimedia Learning*. Prentice Hall Europe. 1997. Essex. pp 101-110. ISBN 0-13-242215-8
- [6] DUFFY, T.M. and JONASSEN, D.H. Constructivism: New implications for instructional technology?. *Educational Technology*. 1991.vol. 31, num. 5, pp. 7-12.
- [7] DURBRIDGE, N. *Interaction in multimedia*. 1997. <http://www6.open.ac.uk/h802/resources/durbridgeInteraction.html>.