

TO USE THE COMPUTER – A BETTER WAY TO UNDERSTAND PHYSICS

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Abstract: Physics laboratory has been for a long time an important part of school physics education. The role and contribution of Multimedia (MM) to teach/ learn the specific physics topics and integrated MM activities in school work, in home work and in distance learning are very important.

In the first part, it was explained why it is important to use MM, and the modern tools and their classification were presented. Next, the lesson plan accompanied by exemplification of how the teacher can integrate audio – video tools during the different stages of the learning units was described.

1. INTRODUCTION

Our society is a technological society. Important informative changes require modernizing the educational programs. Physics is introduced in a modern and attractive way using the Technologies of Information and Communication. Multimedia in Physics Teaching has one important impact for the teaching/ learning process. (Iskander, 2002), (Esquembre, 2002), (de Jong, 1999), (Almeida, 2003).

The Computer Assisted Instruction stimulates the visual and hearing memory and transposes the student in the middle of the phenomena. While teaching Physics, we can attach simulations, animations, and real time interactive computer modelling along with the traditional resources and experiments. The simulations can face issues that are difficult to be treated in other ways because of their abstract character or because of their needs for animation. Many examples can be found in fields like the introduction of mechanics, optics, electricity, thermodynamics etc.

The modern aids used in Physics classes are the school lab, the textbooks, the exercise books, the board and the chalk, audio and video equipment, calculation means and instruments, means of evaluation, means of planned teaching. The training films or the lessons on the computer are the most representative. The realism of dynamical pictures, the video joined with the sound and the motion, the possibility to recreate the physical reality with video technique, digital technique or, lately, with computer technique make the didactic movie the most important teaching aid. The movie must be integrated into the class, as teaching tools and not as an intention. It will be used in a special stage of the lesson, according to the logical structure or the strategies involved.

2. MODERN TOOLS USED IN PHYSICS

The modern tools are general instruments, devices, school supplies that are adapted and selected to process and transfer information and to assess the results. They must disseminate and assimilate the information, but also they must estimate the results. The modern resources are specially invested with pedagogical functions, with a view to communicate, reinforce knowledge, evaluate and apply practical knowledge.

Due to the great progress of the informational technology in the past decade, the multimedia technologies occupy a very special place. Modern technology refers to video spotlight, electronic board, adapted software for Physics or other software that can be used during the Physics classes.

The modern tools (Tereja, 1994) are classified into:

a. informative-demonstrative tools:

- logical – intuitive natural tools (instruments, appliances, machines, installations);
- special made objects (models, simulations);
- imagistic substitutes, figurative representations (pictures, explicative sketches on the board, drawings, diagrams, plotting...);
- projected representations (slides, movies, videos, didactical TV movies, computer representations made in PowerPoint, Excel...);
- logical – rational tools and symbols (electronic schemes, Physics formulas or laws).

b. investigation, exercise and skills forming tools:

- physics lab equipment;
- measuring instruments, consumables;
- technical equipment (projectors, retro projectors, video camera, other projector devices);
- devices and instruction equipments (computer instruction).

c. *beyond pedagogical specific, the modern possibility can be classified into:*

- equipment physic lab;
- audio – video devices and specific technical equipments;
- experimental design, test models, diagrams, instruction models, mathematical models, evaluation tests.

3. THE MULTI – MEDIA TOOLS AND SCHOOL EDUCATION

The multimedia tools are technical equipments that permit the stocking of the sound or the image and their future reproduction (Nicola, 1994), (Popa, 2005). Multimedia tools are a support to the teaching/ learning process in different topics.

The integrated Multi – Media tools expand the teacher and the student's possibilities in the class. Movies, TV shows, video recording, CDs or DVDs are dynamical tools that are capable to represent the physical process afterwards. The static tools are slide projections.

The audio – video tools are irreplaceable in the class because of the following characteristics:

- *They admit convenient modifications to the temporal or the spatial scale; it is possible to observe the slow phenomena or the fast ones; we can observe the microscopical phenomena or astronomical phenomena.*
- *They can operate, analyse, synthesize the physical reality; they encourage the basic understanding. They permit a better perception of direct observations.*
- *They admit the transition from the general to the particular and reverse; the flash back encourages the understanding and the consolidation of the knowledge.*
- *They divert the students' attention from important aspects in a convenient order.*

We can use these modern aids together with the traditional ones; they are complementary and they do not exclude the didactic experiments. Together with other tools, they diminish the learning effort for students and also the teacher's effort to coordinate the learning process. Of course, there are few drawbacks, because the student is passive, he is a simple information receiver and the pictures shown in excess can block the general intellectual development. I refer to the student's abstract thinking and to the student's rich and diverse language. The student must learn to translate the message and he can instruct and teach himself.

To forestall these inconveniences, the teacher, during the class, can ask different questions, can stress few special important moments. In this manner, the student's attention is orientated, his thinking and his data processing capability are mobilized. The students are invited to observe the detailed elements that aren't easily recognizable. The teacher can initiate the analysing process, the synthesis process, the comparison, the reasoning; conversation is the most important method associated with these processes during the class.

The student's inactivity can be eliminated by discussions, debates in class, by the quality of teacher's tools, by continuity between ideas, by picture rhythm; all these allow students to fully understand every picture messages and to process them.

The pictures are more suggestive; the students can think that they understand but this lasts a moment and it is apparent; the teacher must insist on a good feed-back, in order to get over superficiality.

The training films or the lessons on the computer are the most representative. The realism of dynamical pictures, the video joined with the sound and the motion, the possibility to recreate the physical reality with video technique, digital technique or, lately, with computer technique make the didactic movie the most important teaching aid. The movie must be integrated into the class, as a teaching aid and not as an intention. It will be used in a special stage of the lesson, according to the logical structure or the strategies involved. Before the didactic movie or the PowerPoint slides, the teacher must talk to the students, must prepare them for an optimal reception of the message.

4. COMPUTATIONAL BACKGROUND

4.1. AeL SYSTEM

The IT-Based Educational System (SEI - from Romanian "Sistem Educational Informatizat") is a complex program initiated by the Ministry of Education, Research and Youth (MERY) and its basic objective is to support the teaching/ learning process in the pre-university education system with cutting edge technology. (<http://www.advancedelearning.com/index.php/articles/c3>) AeL is a computerized Educational System (SEI), created by Siveco Romania. AeL offers support for teaching / learning, assessment and scoring, administration, planning and monitoring content. It

also provides the means of communication and synchronization between local and regional centres within the SEI program. (<http://portal.edu.ro/index.php/articles/20?catid=142>) AeL allows viewing and managing educational content such as interactive materials, tutorials, exercises, simulations, educational games. The library of educational materials is adaptable, configurable, it has an index and allows easy search. Educational AeL is a complementary (and not an alternative one) classical teaching methods. (Figure 1)



Figure 1 (SIVECO)

SEI optimizes the synchronous learning because the teacher can control the whole lesson in order to create, coordinate and monitor the educational process. The tests are integrated with the study of students' schedules, keeping track of the evolution of each student.

"Advanced e-Learning Objects are an excellent example for a new approach to e-Learning. The digital material can be used in various learning environments, and it covers a huge range of subjects: Mathematics, Physics, Chemistry, History, Biology, Computer Science, Geography and Technology. The product gives the teacher great flexibility and is an excellent tool that promotes a student-centred approach. It has a very nice and clear design that significantly contributes to the understanding of the content. Rich in multimedia features, the product is a best practice example for new trends in e-Learning". (<http://www.advancedelearning.com/index.php/articles/c311/en>)

AeL is conceived as an ongoing support that allows learning in the classroom but also as a product of the future, offering students the opportunity to learn anywhere and anytime.

4.2. CROCODILE PHYSICS

The audio – video tools are technical equipments that permit stocking the images, the sounds and their future reproduction (Nicola, 1994; Jinga and Vlăsceanu, 1989).

The software that will be used is Crocodile Physics 605, which is dedicated simulation software for physics experiments.

The simulation will be in front of the classroom, the teacher will present it on the electronic board or video projector. If the school has a physics laboratory with a computer on each table, the experiment can be practiced by each student.

5. CONCRETE RESULTS

Lesson plan: Lens

The learning unit: Geometrical Optics

The form (gradual level): the class-9th grade (the student's age – 15 years old)

The name of lesson: *Lens*

The type of the lesson: consolidation

The didactical tools: video, TV, videocassette – application of Lens, the training films or the lessons on the computer, experimental kit and after, completed with simulation on the computer AeL system soft (Figure 2, Figure 3) or Crocodile Physics (Figure 4).

The didactical intention: teaching the notion of lens and construction of images in convergent lens.

Instructions for students: Independent activity.

- The teacher will verify the knowledge, which the students must learn - The reflection and refraction of light. (<http://www.advancedelearning.com/index.php/articles/c323>)
- The teacher will make connection with the new lesson.
- The teacher and the students start a practical activity – optical kit.
- The teacher and the student use Lesson on AEL System (figure 2, figure 3), or simulation on Crocodile Physics (figure 4). The simulations are similar with the practical activity, and the students must observe, practice and draw conclusions.

Să construim imaginea unui obiect într-o lentilă convergentă

Deplasați obiectul față de lentilă în pozițiile indicate pe axa optică principală și urmăriți corespondențele cu tabelul din imagine.

Poziția obiectului	Caracteristicile imaginii			
	Poziția	Natura	Sensul	Mărimea
$d > 2f$	$f < d' < 2f$	reală	răsturnată	$ < 0$
$d = 2f$	$d' = 2f$	reală	răsturnată	$ = 0$
$f < d < 2f$	$d' > 2f$	reală	răsturnată	$ > 0$
$d = f$	la infinit	reală	răsturnată	infinită
$0 < d < f$	la intersecția prelungirilor razelor	virtuală	dreaptă	$ > 0$

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Figure 2(SIVECO)

- The teacher must guide the students to draw conclusions, to generalize their observations.
- The teacher observes that the students draw correctly the diagrams and write the equations and the definition in their notebooks.
- The students identify application for *Lens – The Eye – Optical Instrument*.

The crystalline can be regarded as a convergent, biconvex lens. A standard eye has different object - image focal depths, $f = 15.7$ mm and respectively $f = 24.4$ mm. For the normal eye, the image focuses on the retina. The nearest distance for clear vision in case of a standard eye is 25 cm (near point). The eye resolution (the capacity to separately distinguish two nearby points) for this distance is 75 μ m. In the ideal case, the image focuses towards the vitreous (aqueous humor).

In order to focus a clear image on the retina the crystalline lens changes the curvature radius for the two lenses delimiting to which it is commonly composed.

Figure 3 Distance Accommodation of Crystalline Lens. (<http://www.advancedelearning.com/index.php/articles/c323>)

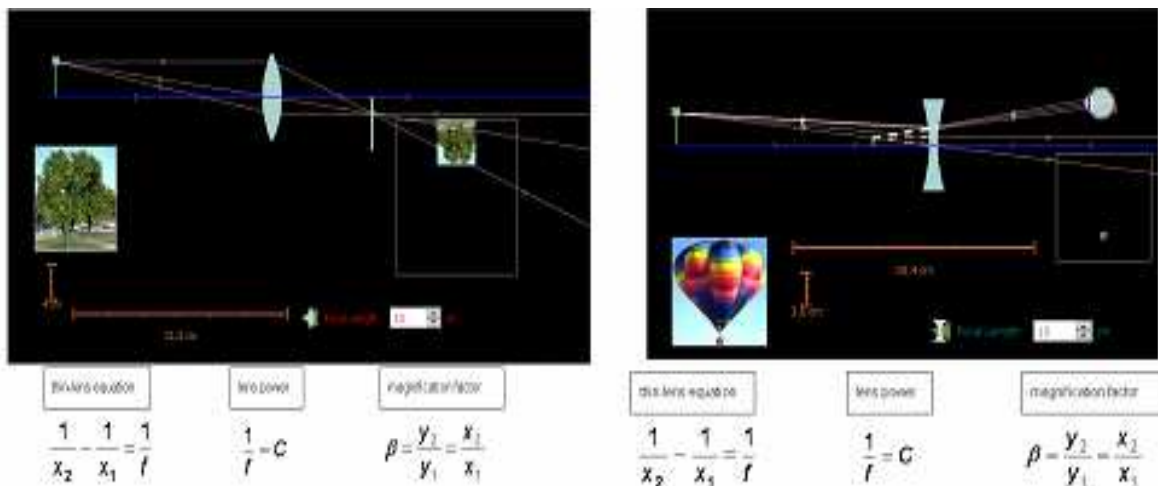


Figure 4 Print Screen – Crocodile Physics, Images in lens

6. CONCLUSIONS

A good lesson, a successful one is achieved when the teacher and the students work together. The teacher must choose the appropriate teaching methods, types of activities and interaction by taking into account the level of his/ her students, the materials he/she has and the goals. Activities can include both traditional experiments and other modern tools, like audio – video tools, when the students must observe, practice and draw conclusions. Methods used must vary; they must be according to the topic, taking into consideration the students' response or the moment of the lesson. Both traditional and modern methods like: demonstration, problem-solving, observation, conversation, learning through discovery, modeling on the computer, didactical games on the computer or practical games must be corroborated during the didactic process. The lesson will prove to be successful if the students understand the concepts and use them in exercises and problems. The teacher can avoid improvised or useless activities and stimulate his students to progress gradually, by avoiding boredom and lack of interest, wasting time and effort. The lesson must contribute to their systematic knowledge and to their maturity. The information they learn must be used in everyday life, so that teaching and learning can connect with their life.

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