Some experiences using ITC based course materials for teaching high school Physics at the Universidad Michoacana de San Nicolás de Hidalgo, México

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Abstract

A main concern on education politics in Latin America is to offer quality education to the wide public. This is a challenging task that requires profound conceptual, organizational and cultural changes. But it is now clear that there are new ways to implement these changes due to the rise of a paradigm based on the strong new relations between the school curricula and the use of ITC based teaching materials, especially those related to informatics and telecommunications. Modern technologies give the students a new chance to acquire specific abilities and competencies by means of directed activities in the physics class. The main goal of such activities is to promote a permanent change oriented to self-learning in the high school students.

Keywords: ITC, Physics Education at the high school level.

Resumen

Una de las principales preocupaciones en la política educativa en América Latina es el ofrecer una educación de calidad para el público en general. Esta es una tarea difícil que requiere de profundos cambios conceptuales, organizativos y culturales. Pero está claro que ahora hay nuevas formas de implementar estos cambios debido al aumento de un paradigma basado en las fuertes relaciones nuevas entre los planes de estudio y el uso de materiales de enseñanza basados en TIC, especialmente las relacionadas con la informática y las telecomunicaciones. Las modernas tecnologías dan a los estudiantes una nueva oportunidad de adquirir habilidades y competencias específicas por medio de actividades dirigidas a la clase de física. El objetivo principal de estas actividades es promover un cambio permanente orientado al auto-aprendizaje en los estudiantes de secundaria.

Palabras clave: Tecnología de la información, enseñanza de la física en el bachillerato.

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I. INTRODUCTION

It has been asserted that the social and economical context of Mexican students is a disadvantaged background for them [5]. Certainly, most of the high school students at the Universidad Michoacana belong to families with very low per capita incomes. In addition, due to long standing social movement tradition, a rather large number of them are brought to Michoacán from small villages in some southern Mexican states in which Spanish is not the first language. Furthermore, when they are incorporated into a school environment, they have to deal with teaching materials that have been designed for an English speaker and translated later, often with severe deficiencies, to be used with a Spanish speaker.

These facts might become into a serious limitation to their learning potential, as well as to their self-confidence and future academic trajectory. At the same time, it is quite clear that a number of these students uses with ease mobile communication devices, as well as some social networks. They can use several search engines, and play collaborative network games, even without the aid of handbooks or tutorials. Thus, a question that arises in a natural way is whether the use of technological ITC based teaching materials can be used in order to overcome these problems and improve the learning process. In this short paper, we discuss very specific and oriented strategies that can be applied for teaching high school physics, and propose some tutorial activities that can be a strong asset in such scenario [4].

One must note that in these activities a very important feature is the habilitation of the teacher, as well as her/his academic competencies. To achieve significant learning, the teacher must be able to conduct academic activities using for the effect many possible strategies, and due to the heterogeneous capabilities and backgrounds of the students, the ability to adapt quickly to a very dynamic scenario is also required.

Another important issue is the use of well-structured, probably redesigned, syllabus. The standard physics syllabus is based mainly on historical facts; this is the reason to devote a large amount of time to mechanics. However, previous experiences have shown that it is possible to teach some modern concepts of dynamical systems to students with a modest background on kinematics and analytic geometry [2, 3]. But this is no a common experience in our context yet. At the high school level of our University, we have detected a complete lack of technological resources. Most of the courses are focused on traditional teaching, which is truly a long established tradition on science teaching, but with poor results in our context.

According to the University curricula, the main objectives of each course are clearly defined; according to the University statistical information, most of the courses are satisfactory completed. Nevertheless, up to our knowledge, courses syllabus is frequently not completed, the students find the science courses rather uninteresting, and very few teachers use technological resources to reinforce important concepts. In addition, physics courses are considered very often as difficult courses, and the failure percentage is large.

The main objective of this paper is to address the use of video streams and dynamic tables in electronic spreadsheets to reinforce the concepts of uniform and uniformly accelerated one-dimensional motion, since these two issues are the most important ones in the first high school semester.

II. METHODOLOGY

The two kinematical concepts described above were first discussed in the classroom by means of traditional teaching and also using presentations with a number of animated slides. Next, the students are given some homework assignment that must be solved in a standard way using a calculator. After that, the homework is solved and discussed in the classroom also in a standard traditional teaching way.

The following step includes computer laboratory sessions conducted by the teacher, which are used to apply a set of different Open Office workbooks were the initial position, velocity and acceleration values are fully customizable. At the end of these sessions, the previous homework problems are solved, and the difficulties and advantages of the use of the workbook compared to the calculator are discussed.

These presentations and workbooks were provided to the students as a complement to the course references after they were presented. The workbooks were also used as a new "calculator" for more homework assignments.

III. RESULTS

Some conclusions were easily drawn from the tests and the discussion:

1. The students strongly agree they understood much better with the aid of the presentations, since they can "watch" the motion.
2. They also agree that the workbooks helped them to improve their skills to solve problems. However, a number of them also considered that they should solve most problems in a standard way too.
3. They consider that, after the use of the workbooks, they are better trained to solve the problems using only a calculator.
4. The students suggested that they should be given the new materials at the beginning of the course.

After these experiences were conducted, 15 students were selected at random from a group with 50 students. They were asked to solve a standard test; the grades they obtained can be seen in Fig. 1.

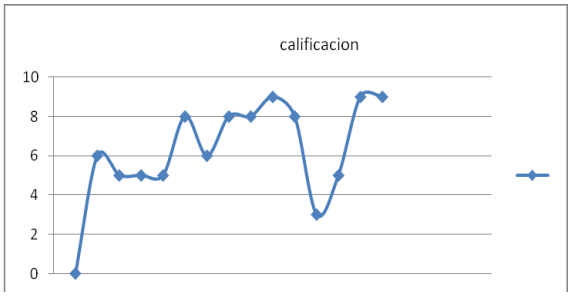

FIGURE 1. Grades obtained by the randomly selected students.

As it can be seen, 60 percent of the students pass the exam. This percentage is considerably larger than the standard, which is usually below 20%.

IV. CONCLUSIONS

As in [5], these results suggest that it is possible to obtain highly satisfactory results with students with disadvantageous backgrounds. The use of new technologies can be a great aid to improve the learning process in physics. But it must not replace traditional teaching, whose teaching potential in science is clearly strong, but complement it. However, this paradigm requires a different profile the teachers should fulfill.

The experiences addressed above are only a first example of the activities of a long and mid-term research project. A much larger experimentation is currently been carried out, involving a larger number of students and the development and application of some other materials

related to more concepts. The corresponding results will be reported in a future paper.

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