Instrumentación de una estrategia de aprendizaje para la enseñanza de los fenómenos de transporte en las carreras de Ingeniería del Instituto Nacional de México mediante el empleo de simuladores digitales

Implementing a learning strategy for teaching transport phenomena in the Engineering of the National Institute of Mexico by using digital simulators

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Resumen

Nuestro trabajo consiste en el diseño, construcción e implementación de prácticas de enseñanza universitaria que incluyen desarrollos de las nuevas tecnologías de la información mediante estrategias de aprendizaje adecuadas para lograr un aprendizaje significativo de la transferencia de calor que se estudia en la gran mayoría de las carreras de ingeniería del Sistema Nacional de Educación Superior Tecnológica.

El propósito principal es diseñar una estrategia de aprendizaje y enseñanza de los fenómenos de transporte a través del diseño e implementación de las prácticas y el análisis de la forma en que se utilizan los simuladores en la enseñanza universitaria. Nuestro trabajo va más allá de la simple incorporación de un programa de cómputo, ya que comprende un diseño de prácticas de trabajo basadas en una buena estrategia de aprendizaje, su seguimiento, su utilización en un curso oficial en el plan de estudios, la evaluación del mismo, así como el manual de los profesores que van a utilizarlo en una o más unidades de su curso.

Para ello, primero se utiliza el lenguaje C++, construyendo la interface correspondiente de acuerdo a estándares internacionales. Posteriormente se implementa la estrategia adecuada para su aplicación en las clases de transferencia de calor, y se proporciona a los profesores para ver la manera adecuada de aplicarlo. Finalmente, se lleva a cabo la evaluación tomando en cuenta tanto a los profesores como a los alumnos y la estrategia empleada.

Palabras Clave: estrategia de aprendizaje, fenómenos, carreras de Ingeniería, simuladores digitales.

Abstract

Our work involves the design, construction and implementation of university teaching practices including development of new technologies of information through appropriate learning strategies to achieve meaningful learning of heat transfer is studied in most of the races Engineering of the National System of Higher Education Technology.

The main purpose is to design a strategy for learning and teaching of transport phenomena through the design and implementation of practices and analyzing how simulators are used in higher education. Our work goes beyond the simple addition of a computer program, and which comprises a design work practice based on good learning strategy, monitoring, use in a formal course in the curriculum, assessment same as well as the manual for teachers that will be used in one or more units of their course.

To do this, first the C ++ language is used, the corresponding interface built according to international standards. Subsequently the right strategy for application in classes heat transfer is implemented, and provides teachers for the proper way to apply it. Finally, we performed the evaluation taking into account both teachers and students and the strategy employed.

Key words: learning strategy, phenomena, engineering careers, digital simulators.

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Introduction

The educational software program or application that is performed for the purpose of using it as a facilitator of the teaching and learning process accordingly. Educational software is that education and training program, synonymous to refer generically to computer programs created with the specific purpose of being used as a teaching tool, that is, to facilitate the teaching and learning (Marquis, 2003: 2).

Its history goes back to the twenties, when Sydney L. Pressey developed the first programming system and the first teaching machine. It continues its development and it was not until the sixties when they join the company IBM and the Institute for Mathematical Studies in the Social Sciences (IMSSS) of Stanford University, directed by Patrick Suppes, with the aim of developing the first CAI (Computer Aided Instruction) based on the curriculum of primary school, and implement its use in schools in California and Mississippi in the United States. It was the first time the computer contents and construction were determined according to the school curriculum. In the following decades these applications evolved into the concepts of CBT (Computer Based Training) and CBI (Computer Based Instruction) that were not supported only on devices but in educational programs running on a computer platform.

The concept of educational software continued its development and today, according to Marques, has the following characteristics:

a) The materials are made with a didactic purpose;

b) use the computer as a medium in which students carry out various activities;

c) They are interactive, "react" immediately to the actions of students and allow a dialogue and an exchange of information between the computer (or device) and students;

d) Individualized work of students, as they adapt to the pace of work of each and can adapt their activities as the performances of the pupils;

e) They are easy to use. The necessary computer skills to use most of these programs are similar to the skills needed to use electronic video, although each program has rules of operation that must be known.

There are other classifications or typologies of educational software, which are based on aspects:

- The media that support us, those incorporating multimedia, those that are based on the hypertext paradigm, and making use of virtual reality.
- The educational objectives to facilitate the learning of concepts, procedures and / or attitudes.
- Cognitive activities active: that is, they can promote observation, memory, psychomotor control, understanding, interpretation, comparison, analysis, synthesis, it is based on problem solving as a means of expression for the creation and experimentation.
- The psycho-pedagogical foundations that support and guidance on learning: based on behaviorism, cognitivism and constructivism.
- The role in teaching strategy: are used to train, to educate, inform, motivate, explore, experiment, evaluate, entertain, and so on.
- The design: learning-centered, focused on teaching, student-centered, provider resources, among others.

In short, we can say that educational software is a computer program that is used to educate the user. This means that educational software is a technological tool that has a pedagogical or educational function which by its nature helps acquiring new knowledge and skills development.

There are different kinds of educational software. Some of these programs are designed to support the teacher. Thus, the teacher or teacher attending the software to deliver their lessons or to reinforce a class. Other types of educational software, however, are geared directly to the student, offering a real or virtual environment where you can learn on your own.

Educational software is very important in distance education but also in the face because these technological tools to simulate the conditions in a classroom or industry where the student will be incorporated at the end of their stay during their schooling. Thus, the student can "enter" into a room or industry virtually, interact with teachers through videoconferencing, chat or email, complete evaluations, and so on.

Importantly, like textbooks are classified according to age, educational software is also aimed at specific segments of students. The draft before us today and according to the need to awaken the student's scientific curiosity, we favor software whose main function is the simulation, which leads to the realization and understanding of simulated experimental situations that allow them to learn and solve real situations you will face in the performance of his specialty but with a theoretical basis.

From experience and results obtained by teachers after using these programs, educational software was chosen because it was observed that has a motivating and innovative role in the student, particularly to draw your attention to "new" tools. In the background, but not least, it is the instructive function of regulating student learning. Regarding free software, we can say that is insignificant 'use of them.

The simulators were chosen according to the function of educational software in the teaching strategy that is oriented towards experimentation and procedural characteristics. They aim to provide information on basic concepts and build general knowledge, and apply these to new contexts that, for various reasons, the student can not be accessed from the methodological context (the classroom) which develops learning. In fact, much of the cutting edge science, frontier, are increasingly based on the paradigm of simulation (Diaz Barriga, 2010). Using simulators can be developed engineering experiments in the lab with greater security, ie simulate risk situations without any real danger; so when the student reaches the industry will be prepared to meet contingencies.

Convinced of this we return to the main characteristics of simulators applied in education. For the author Marqués they must:

1. Supporting experimental learning.

2. Allow the learning exercise.

3. Provide a open learning environment based on real models.

4. Provide a high level of interactivity.

5. Promoting exciting and entertaining situations that serve as a backdrop to learning a particular topic.

6. Support the active nature of the user, who becomes the builder of his learning from their own experience.

This project deals with the use of new technologies as an alternative to solve the challenge in the training of students on the operations of heat transfer engineering, particularly when you do not have laboratory equipment. This, of course, still be an excellent introduction to a series of experiences of teaching, with the support of a computer and a program of interactive simulation laboratory.

You can also be a form for Distance Learning, as it is as effective as traditional forms of classroom education when appropriate methods and technologies are used, that is, when there is interaction between teachers-students and when they have timely advice of the facilitator (Rivera Gallegos, 2007).

In this project the didactic application of simulation games at the university level as a tool for teaching-learning process in engineering, particularly in heat transfer phenomena is sought.

The multidisciplinary nature of the simulation, together with the growing student interest in new technologies and the way how are you positive influence on their motivation and pro-activity in the teaching-learning process is sought and, therefore, in setting in practice the theoretical knowledge acquired by them in the classroom.

The aim is to achieve increasing skills and / or skills through group work and individual.

Background

All races of Chemical Engineering and others as Food Engineering, Natural Resource Management, Mechanical, Nanotechnology, etc., studying in their common core transport phenomena, which are the professional basis of these races, and for the study of these is required the application of differential equations.

The study of these transport phenomena has been a complex matter, since in her prior learning acquired in Chemistry, Physics, Mathematics, material balance and more, knowledge that most students do not apply well grounded, so it is necessary to develop strategies for learning these subjects.

Surely the teaching of transport phenomena have major deficiencies, coupled with the fact that some of our students and our teachers apply only unit operations mechanically, without really understanding the process and working by trial and error, which is a serious matter in an engineering school. This situation has been worsening with the onset of simulators as CHEMCAD, Highsys, etc., where they are given all already digested the student and the teacher, who only have to see what unit operation is applied and currents involved. With this you can get spectacular results, but hardly our students and some teachers really understand the phenomenon occurred. Therefore it is necessary to have a tool that helps us understand the phenomenon itself and power, among other things, reengineering. Interestingly some years ago he participated in a course on Sustainable Development at the Technological Institute of Oaxaca, where you can modify a process, which interestingly was required above all was truly know the process, which could verify some of my teammates in the course.

We find, especially on the Internet, many "applets" that are usually used incorrectly or without a guide, so not conducive to learning and become mere "toys".

This we can ensure after more than fourteen years of teaching experience in the area of technological schools.

It is necessary to develop in students the ability to handle the heat transfer phenomena that are mainly applied in the balance equations. This carried out in only two courses causes our students to become mere "applicators" formulas in situations that most often they are not very clear. The lack of practice and visualization of the phenomenon can be solved by using simulators.

To overcome the above is necessary to give the student support tools that allow you to apply the knowledge and at the same time develop strategies for better utilization and, therefore, achieve a deep knowledge of the subject that will allow you to successfully face the unit operations .

According to an observational empirical approach it has been found that failure rates of students are very high and also the contents of the subject are not studied in its entirety.

To solve the problem indicated digital simulators are currently used, however, the vast majority are general marketing programs and various unit operations oriented purposes, why in our work we seek to develop a simulator for the stage prior to the unit operations where students learn the fundamentals and subsequent courses can apply them successfully.

However, the single tool does not guarantee success, so it should be accompanied by an implementation strategy with a well planned methodology based on appropriate learning strategy, conduct an evaluation from (NOT RATED) and above all, training the teachers of the subject so that they can not only meet the simulator but also accompany the students.

So our project will first develop the application program and then implement a strategy for its implementation, assessing the tool in their implementation; In addition, it must follow up the results regarding the academic impact, implying that in a second step, after making the user manual, a manual for teachers to develop and will prepare him to get the best results by appropriate learning strategy.

Theoretical framework

From the educational point of view, we place the student at the heart of teaching-learning process, akin to the constructivist learning paradigm, supported by the theories of Bruner (learning by discovery) and Ausubel (meaningful learning) (Ferro Fernandez, 2010).

Bruner in Diaz Barriga (2010) suggests that learning should be perceived by the student as a set of problems and gaps that need. For learning to be really significant and important the student must take an active part in the process of acquiring knowledge and not be a mere recipient thereof. Meanwhile, Ausubel [2] suggests that learning is significant to the extent that is generated in an environment and conditions which enable its relationship with all the previous experience of the student.

Methodological framework based on constructivist learning strategies arise, such as problem-based learning, cooperative learning and the case method.

"In problem-based learning, the fundamental question (from a practical point of view) is that students discover what they need to learn to deal with the problem posed. Students should know how to diagnose a problem from the facts and hard data and not only solve one already raised. In this respect it differs from the so-called theme-based learning, where the teacher establishes what students should know and function of the latter is to learn to finally apply it to solving problems that are assigned to them "(Arias Aranda D., 2009, p. 718).

The paradigm of cooperative learning beyond the traditional competitive system of learning among students and uses a system of collaboration between them and teamwork. Cooperative learning, properly developed, ensures that students get involved conscious, physically and emotionally to build their own knowledge and develop relevant skills (D. Arias Aranda, 2007).

For quite some time ago, the training of professionals in engineering and other disciplines has been using the strategy of case study (or studies) as a method of teaching.

In the training of engineers it is clear that the case studies should be directed to the analysis of specific industry processes. Thus, the case studies should be systematically organized and detailed explanation of different processes in the chemical industry.

Simultaneously, in recent times it has been recognized that the systematic study of basic and complex operations and chemical and industrial processes with a professional projection, can not be addressed effectively without the use of appropriate software tools. In fact, the development of the concept of learning through simulation and process simulation, as a matter of education, is widespread in the Engineering and related in many universities around the world.

The process simulators are gaining ground in university teaching worldwide since they allow, on the one hand, approach the study of complex processes at an affordable cost of time and effort and, on the other, provide students experience in a tool which it is widely used in the professional activity of engineers.

We note that some companies in our country seeking applicants who can handle any of the simulators for recruitment process.

Several researchers have pointed out the benefits of using simulators in university teaching process of Chemical Engineering. For example, Goodyear [14] argues that simulators allow students to understand complex processes and facilities, which are difficult to understand even by direct contact with the installation. Kassim and Cadbury insist that the use of process simulators supports, strengthens and stimulates cognitive independence of students.

Goals

The central objective of this work is to develop an educational strategy focused on the use of computer programs and evaluation oriented, with constructive and cooperative projection, for the subjects of Heat Transfer Engineering Technological Institutes.

It aims to introduce the use of computer programs run as a routine tool in all subjects and career activities requiring heat transfer.

Above all, it seeks to develop a strategy for meaningful learning in the area of heat transfer by encouraging the active participation of students; and train teachers who want to use this tool in their respective courses.

Finally, it seeks to develop a methodology to evaluate and contrast it with students who do not use these programs to verify their effectiveness.

Goals

- Design and implement a computer program using differential equations to simulate the heat transfer processes during learning of the relevant unit operations.
- Develop a simulator manual.

- Training (in situ) especially teachers in the use of this tool.
- Develop a strategy for learning through case studies.
- Develop the corresponding manual for using the tool.

Methodology

Change the teaching methodology of the phenomena of heat transfer, modify the use of problems to increase the efficiency of learning, using models developed in the Engineering and interpretation of results. Consider the views of teachers and students in relation to the lectures of the subject. Change the evaluation model of the same material.

Provide the subject of an eminently practical and applied character, case studies, examples and exercises system used in the subject developed in this perspective and interpretation of results.

Develop the subject with a large number of practical activities, systematically organized. This is intended for students to have enough content to work individually and can not not constrained by the assignment of tasks by the teacher, by experimental proposal already mentioned.

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