A Proposal of Mechanics Multimedia Tutorial

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The Physics I course that imparts the High School of Chapingo University includes Classical Mechanics. To support and facilitate the learning of each concept that covers this science, we present a proposal of tutorial multimedia. The material multimedia can make many functions in the learning process. The main functions that can make the multimedia are: to give information, to guide the learning, to motive, to evaluate, to give the conditions to explore and to experiment, to facilitate the communication, etc. The tutorial will offer an extra tool to support the Physic I course, encouraging the students to learn, create, and experiment in each one of the topics that includes this course. The importance of this kind of proposal is that the natural way of learning is based on the use of some senses as the hearing and sight. For this reason, the tutorial will include images, text, sounds, simulations and animations that will be integrated in order to the student can interact with each topic. To evaluate the learning acquired by the student, it will be implemented questions and exercises about these topics. The system will have an inference motor that will get conclusions by mean of the knowledge base and the answers from the user. The users could use the simulations associated with each topic to see the behaviour of the variables in each simulation. The purpose of this work is that the user centres his attention on the more important topics; it will be necessary to have a friendly, easy and intuitive interface. For this purpose, it is necessary that the interface combines appropriately the multimedia elements. The topics included in this tutorial are: Vectors, Kinematics, Dynamic, Impulse and Quantity of Movement, and Work and Energy. The main objective of this project is to present the information using different means so that the student has the possibility to compare and to verify the learning in class. In this work we will present the topic of vectors.

Key Words Physics; Mechanics; Multimedia; Tutorial; Vectors; Kinematics; Dynamic; Impulse and Quantity of Movement; Work and Energy.

Justification

In the teaching of the physics, abstract ideas are generally managed that are not appreciated easily by our senses, lacking meaning when not being represented. It is for it that the representations play an important paper in the teaching of the physics, since they allow transferring ideas in images that can be appreciated by our senses. With this it is tried to give meaning to an abstract question, which it serves us as connection between the operative thought and the structural one. To generate visual representations of the concepts that are managed in the physics, experiments they should be presented that show the fundamental ideas that settle down in these concepts. In many occasions the experiment is used as tool of confirmation of concepts. For it, it is desirable that each topic that is analyzed go accompanied by an experimental design. However, in many occasions, this objective isn't achieved completely by diverse reasons, among them we have:

1. In some topics it is difficult to implement a demonstrative experiment since it is practically impossible to isolate to the system of the influence of the environment.
2. The team lack.
3. The lack of professors with academic elements to implement laboratory experiences.

Our interest is centred in the use of the computer to create visual perceptions and to be a basic element in the reinforcement of the conceptual images. Because the natural way to learn is based on the use of the senses, it is important to present information to develop concepts using technical that allow the visual,

auditory learning and in tactile occasions. Each person has her own form of learning: there are people whose learning capacity is guided to the written material, other; however, it will be more guided to graphic questions; while another will have a high retention level and acoustic assimilation. Multimedia supports these styles, to elevate the learning capacity [1].

With the coming of the computer, the possibility arose of experiencing with mathematical models. For the first time it was found that they could be carried out controlled experiments of laboratory, using for this computers instead of devices. The rational foundation to use the simulation in any discipline is the man's constant search to acquire relative knowledge to the prediction of the future. Although this it is the main reason of the existence of the simulation, other reasons exist for their employment:

1. The simulation makes possible to study and to experience with the complex iterations that happen inside a given system.
2. Through the simulation the effects of certain informative changes can be studied in the operation of a system, when making alterations in their model and to observe the effects of these in the behaviour of the system.
3. The detailed information of the system that is simulating, leads to a better understanding of the same one and it provides suggestions to improve it that otherwise could not be obtained.
4. The simulation can be used as pedagogic resource, for students and practitioners, when teaching them the basic knowledge in the theoretical analysis.
5. The experience that is acquired when designing a simulation model in a computer can be more valuable than the simulation in itself. The knowledge that is obtained when designing some simulation suggests, frequently, changes in the system in question. The effects of these changes can be proven through the simulation, before implanting them in the real system.
6. The simulation of complex systems can produce a valuable and deep knowledge about which variables they are more important than others in the system and how they work to each other.
7. The simulation can serve like a test of service to rehearse new politicians and rules of decision in the operation of a system, before experiencing with the real system.
8. The simulation allows studying the dynamic systems, either in real time, compressed time or expanded time.

Contrary to other technological means, the computer has been able to enter in the educational environment causing significant changes in him, because in the student some desirable situations are obtained, I eat for example:

1. A language cognitive, when having association of the word with the obtained image.
2. With the use of the computer you can achieve an active learning, that is to say, due to the existent interaction between the student and the computer, it is allowed to explore the information with more detail, without the pressure of the educational one.
3. Of this interaction they arise the dynamic representations of the physical phenomenon that provide, from a psychological point of view, a manipulation of the different processes in a much more fruitful way.
4. The concepts have been modelled and with this it is provided important elements.
5. It is necessary to emphasize the fundamental importance of the conceptual image and the concept definition in the Physics. To achieve a conceptual image they are necessary the visual models and these are obtained of what goes appearing in the screen, giving place to the observation how they leave formed the objects of the physical world.
6. It has been shown that with the use of the computer better results are achieved in the processes cognitive that in the traditional way, since it allows the student to make their own conceptualizations, when exploring in a personal way the world of the physics through the computer. They are also increased in a considerable way the visual representation and this is important because most of the concepts have in some way a representation that is more symbolic than visual [2].

The means for which the user communicates with the program is known as interface, which is a combination of graphic elements. So that the interface is friendly, it is necessary to combine different ele-

ments like images, animations, videos, text, sound, etc. By means of the elaboration of the System Intelligent Tutorial of Mechanics, is sought to create a tool that serves from support to the course of Physical I. An intelligent tutorial it is chosen this type of systems since they offer the possibility to reinforce the contents learned in class; because these programs present the information using different means. With it the student has the possibility to compare and to verify that learned in class, allowing him to make a deeper connection of each topic. It is also important that he/she has the possibility to either consult the material in the home or in the school. The system will have an evaluation module for each topic, that which will allow obtaining information of the acting achieved by the student. The elaboration of Systems Intelligent Tutoriales requires of technical multimedia and the elements characteristic of the educational materials as objectives, activities, contents, evaluations, etc.

In the Preparatoria Agrícola of the UACh it is little the educational software that has been developed. For they exist it many queries about their elaboration. The project has contemplated to try to respond to those queries designing, developing, applying and evaluating a system intelligent tutorial that treats the topic of Mechanics in particular. This way it is looked for to respond some questions as elementary as: What is a System Intelligent Tutorial? Is the STI necessary to support the education or is a simple fashion? Is it education or instruction the one that the STI toasts? What is it required to implement STI in the education institutions? Will it reduce costs in the education the STI? Will the STI promote the individual or collective learning? Is a STI able to promote values? Will he/she be able to memorize through the STI without the professor's help? Will the STI substitute to the educational one? Will the STI in fact facilitate the learning? With the development of the STI, Which will the professor's activity be? With the STI he/she will decrease the number of educational? Will the STI serve to the educational one or will the educational one serve the STI? What intelligence types do the STI, the musical intelligence, the space one, the visual one, the kinestésica, the interpersonal one or the intrapersonal develop? Will the books be totally substituted by the STI? What type of learning wills the STI promote? What theories of the learning will they produce better results in the STI? Will the education at distance be able to democratize the knowledge? Will the education be in hands of the computers? Will one be able to model through a computer the different types of knowledge? Will a computer be able to choose the best pedagogic method to transmit the knowledge? Will the STI be a finished product or will investigation objects be? Will the alone STI be able to be elaborated by specialists and will the professor be alone a mentor? On what paradigms is the STI based for their development? Is the STI an alternative or a complement for the education? With what language is the STI developed? Which language will it be in agreement with the requirements than they are needed to build the STI? How to foment the most active participation of the student located at distance? How to reduce the possibilities of distraction and to increase the degree of attention to the messages that they appear in the screen? Will the students of the institution be qualified to be able to learn through the computer? Which are the characteristics from the students to those that the STI go? Will the STI have the necessary pedagogic elements so that the student captures the knowledge? Will the real or virtual experimentation be fomented through the use of the computer? Will the STI that intends be able to represent the concepts that it manages the Mechanics? Will one be able to foment the conceptual image and a language cognitive? Will the STI that intends be able to achieve an active learning? Will the STI achieve dynamic representations of the physical phenomenon?

Objectives

1. To design, to elaborate, to apply and to evaluate a System Intelligent Tutorial related with the topic of Classic Mechanics, using concepts pedagogic, technical of elaboration of didactic material, concepts of artificial intelligence and engineering of the knowledge and elements multimedia.
2. That the student knows, understand and apply the main concepts of the Classic Mechanics, making emphasis in the fundamental principles of the conservation of the mass, of the lineal moment and of the energy, through the System Intelligent Tutorial.

Methodology

The methodology consists of the following stages [3]:

1. Plan of Text: Description of the characteristics of the population to which the STI goes.
2. Content: Description of the topics that the STI will try.
3. Structuring of the Content: It is the organization of the content in significant structures that facilitate the learning and the transfer of that learned.
4. Objectives: After establishing the content and order in that it will present the objectives they will be specified that the student will achieve.
5. Analysis of the Content: This stage is referred to the identification of the concepts and procedures that it implies the content and the determination of the components of these elements.
6. Elaboration of the Instruments of Evaluation: In this stage they will get ready the reagents for the evaluations and an inference motor where the system will evaluate the student's use.
7. To design of the Didactic Content: To determine the didactic sequences, so that it is demanded the student's active participation continually.
8. Elaboration of the STI: In this stage the STI will be elaborated based on the information obtained in the previous points.
9. To implement the STI: In this stage the STI will be used in the classroom.
10. To evaluate of the STI: This stage implies an investigation work to determine the efficiency and the effectiveness of the STI. It will be evaluated the organization of the didactic resources of the material and the degree of the achievement of the proposed objectives. This evaluation will be made through questionnaires, interviews, and evaluations to the students.

Content

The content is based on the program of the matter of Physical I that is imparted in the Preparatory one Agricultural of the Institution [4]:

1. Vectors.
    - 1.1. Quantities Scalar and Vector.
    - 1.2. Addition of Vectors. Analytic's Method.
    - 1.3. Addition of Vectors. Graphic's Method.
        - 1.3.1. - Method of the Parallelogram.
        - 1.3.2. - Method of the Polygon.
2. Kinematics.
    - 2.1. - Speed.
    - 2.2. - Movement Rectilinear Uniform.
    - 2.3. - Rectilinear Movement Uniform Accelerate.
    - 2.4. – Shot Parabolic.
    - 2.5. - Circular Movement.
3. Dynamics.
    - 3.1. - First Newton's Law.
        - 3.1.1. Mass.
    - 3.2. - Second Newton's Law.
        - 3.2.1. Force.
        - 3.2.2. Weight.
        - 3.2.3. Friction.
    - 3.3. - Third Newton's Law.
    - 3.4. - Angular Moment.
        - 3.4.1. Principle of Conservation of the Angular Moment.
    - 3.5. - Static.
        - 3.5.1. Balance.

4. Energy.
    - 4.1. Work.
    - 4.2. Potential Energy.
    - 4.3. Kinetic Energy.
    - 4.4. Principle of Conservation of the Energy.
    - 4.5. Collisions.
    - 4.6. Power.

Conclusions

1. The development of the STI requires of Programming Foundations [5], Artificial Intelligence and Engineering of the Knowledge [6], Didactics, Pedagogy [7], Psychology [8], etc.
2. The STI should carry out the basic operations of the human intelligence as coding, to store, to compare, to locate, etc.
3. The STI should solve problems, to make decisions, to learn, to understand the natural language, to reason logically, etc.

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