Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Implementación de tecnología educativa para la mejora del aprovechamiento académico en la Universidad Tecnológica de Altamira(UTA)

Implementation of educational technology for improvement of academic achievement at Technological University of Altamira

Implementação de tecnologia educacional para a melhoria do desempenho acadêmico na Universidade Tecnológica de Altamira (UTA)

Edgar Uxmal Maya Palacios
Universidad Tecnológica de Altamira, México.
emaya@utaltamira.edu.mx

José Genaro González Hernández
Universidad Tecnológica de Altamira, México.
jggonzalez@utaltamira.edu.mx

José Luis Ocampo Casados
Universidad Tecnológica de Altamira, México.
josecasados@hotmail.com

Resumen

La presente investigación se realiza en la Universidad Tecnológica de Altamira (UTA) en el Departamento de Mecatrónica, donde se trabaja para incrementar el aprovechamiento académico de los alumnos en la materia de Sistemas Hidráulicos y Neumáticos (SHYN), para lograrlo se indaga mediante la implementación de la computadora y software de simulación fluid-sim-p, recurriendo a un problema en el que los estudiantes comprendan los conceptos usados a una aplicación práctica en su área, con el propósito de realizar una comparación entre dos grupos: uno de ellos utilizando el software de simulación y otro trabajando de forma tradicional. Finalmente se evaluaron los resultados obtenidos con el desempeño académico.

El trabajo se efectuó durante cuatro meses y los resultados obtenidos muestran una mejora de los estudiantes en cada uno de los indicadores.

Palabras clave: tecnología educativa, SHYN, aplicación práctica, desempeño académico.

Abstract

This study was conducted in the Mechatronics Department at the Technological University of Altamira (UTA), where work is being done to boost the academic performance of students of Hydraulic and Pneumatic Systems (Spanish acronym: SHYN) by investigating the use of the computer simulation software FluidSIM-P. Focusing on an exercise in which the students learn to apply practical concepts, two groups could then be compared: one using the simulation software, and the other using traditional methods. Finally, we compared the results with the students' academic performance. The study was carried out over a period of four months, and the results demonstrate that the students improved according to each one of the indicators.

Key words: Computer, simulation software, meaningful learning.

Resumo

Esta pesquisa é realizada na Universidade Tecnológica de Altamira (UTA) no Departamento de Mecatrônica, onde o trabalho está sendo feito para aumentar a realização acadêmica de estudantes no campo de Sistemas Hidráulicos e Pneumáticos (SHYN), para atingir isso é investigado através da implementação do software de computação e simulação fluido-sim-p, recorrendo a um problema em que os alunos compreendem os conceitos usados para uma aplicação prática em sua área, com o objetivo de fazer uma comparação entre dois grupos: um deles usando o software de simulação e outro trabalhando de forma tradicional. Finalmente, foram avaliados os resultados obtidos com o desempenho acadêmico. O trabalho foi realizado por quatro meses e os resultados obtidos mostram uma melhoria dos alunos em cada um dos indicadores.

Palavras-chave: tecnologia educacional, SHYN, aplicação prática, desempenho acadêmico.

Fecha Recepción: Enero 2017 **Fecha Aceptación:** Julio 2017

Introduction

The problem that guides this research in the career of Mechatronics is the high rate of failure in the subject of SHYN, which works with technical specialty subjects looking for students to increase academic achievement through the use of educational technology such as computer and software fluid-sim-p applied in a problem, in order to acquire a visual panorama that provides a response when developing their cognitive skills based on practical exercises.

The practical exercises related to the simulation of software through the computer have become an important part of the modern world, by including them in the automation processes for industrial control, facilitating the detection of faults, reducing connections or components present in circuits, optimizing the process time, minimizing operating costs and reducing accidents of short circulito.

"Simulation is the process of designing a real system model and carrying out experiences with it, in order to understand the behavior of the system or to evaluate new strategies within the limits imposed by a criterion or group of them for the operation of the system. system "(Shannon and Johannes, 1976).

The Technological University of Altamira, as part of the institutions of higher technological education in Mexico, offers careers whose study programs include computer management (UTA, 2017), with the use of the simulation software fluid-sim-p increases the academic achievement of students, providing advantages to detect failures and real errors before being connected in real life, as seen in the area of Mechatronics, starting from a pedagogical point of view, the question that guides this research is:

How does the computer and simulation software intervene in the academic achievement of Mechatronics students in the UTA?

In this way a problem is proposed so that the students can understand the concepts applied to a practical situation using the computer and the simulation software fluid-sim-p, with the purpose of making a comparison between two groups: one of them using the simulation software fluid-sim-p and another working in the traditional way. Finally, the results obtained in the academic performance of the students were evaluated.

Theoretical fundament

The first relationships with the computer were instrumental since it was conceived as a kind of giant calculator to which the human being could give orders following a set of basic rules that constituted their intrinsic formal logic. If the operator knew these rules, he could give orders to the machine causing them to execute them in a simple and clear way, it was a logic of doing-doing: I subject the object machine to do what I ordered.

Sherry Turkle argued that the first stage of computers belongs to a "culture of calculation" that was replaced in the eighties by a "culture of simulation", navigation and interaction. Turkle places this change in 1984, with the introduction of the iconic iconic style of the Macintosh interface, which simulated the space of a desk (the icons), establishing a communicative link based on interaction and human-machine dialogue.

The simulation of software plays a substantial role in scientific research, also in education is increasingly used to accelerate the learning process of students in the teaching of processes, procedures and training of practical situations; One of its most current forms is what is known as virtual reality that allows us to deceive our senses to make us feel in a different environment than we are in reality.

Since its inception simulations were used almost exclusively for the professional training of aviator pilots, so their origins, like those of the Internet, were clearly military. E. A. Link Jr., creator of the first commercial flight simulator in the world, pointed out in the 1930s that his simulator was "a combination of training device for aviation students and entertainment apparatus" (Manovich, 2005).

The double facet of training present in most simulators is that where the user learns to move interacting with the environment in an entertaining way. In the seventies and eighties, the development of interactive 3D imaging technology by machine allowed the simulation of the characteristics of the landscape that a pilot normally sees and the possibility of interacting with them, which determined the type of exploration of the simulators.

The simulators presented a problem at a high cost; Until 1990, companies such as Evans and Sutherland, Boeing and Lockheed were in charge of developing multimillionaire simulators, but when military orders began to decline, they had to look for other applications to consume their technology. Thus, these and other companies turned their expensive flight simulators into recreational games, movie attractions and other forms of entertainment.

The entertainment industry and the military often came to share the same technology and use the same visual forms, something that has been brilliantly exposed by Paul Virilio, highlighting the parallels between the military and film cultures of the 20th century, which include the use of a mobile camera that moves through space, military aerial surveillance or cinematographic photographs (Virilio, 1989).

This is the world in which most educators have focused recently, apparently because it offers a relatively stable, accessible, cheap and habitable platform in which it is possible to build simulations, laboratories and places for education (Carr, 2008).

The advantage of simulation as a mode of knowledge and learning, highlights the visual aspect and assimilation with the possibility of seeing them change in real time, which is a great help for our short-term memory and an amplification of imagination and individual intelligence and collective (Lévy, 2007).

Methodology

The teaching-learning process suggests the change in traditional training methods, relying on technological education, breaking with the monotony and boredom in the classrooms, taking into account the presence of visual, auditory and kinesthetic students, the idea of this proposal is make use of technologies such as computer and software fluid-sim-p by resorting to a theoretical-practical problem in order that students relate theoretical knowledge and apply them to practice, increasing significant learning.

It was proposed to use the topic of pressure to understand more complex phenomena that are the basis of disciplines such as pneumatics, hydraulics, instrumentation, automation and process control whose industrial applications are of great importance for the daily life of students and the society in general. Pressure can be considered as an integrating theme by consensus in the different areas of education.

In education, the issue of pressure is relevant when thinking that it can be found in an integral differential calculus class, where it is explained that it is the sum of differential elements of force applied in enormous magnitudes; in the same way it is presented in a hydraulic control and control system applied in backhoes, crane systems, elevators where pressure needs to be determined by means of pneumatics.

Pneumatics is the set of technical applications such as transmission, transformation of forces and movement that use the energy accumulated in the compressed air, the word itself comes from the Greek expression pneuma, which refers to breathing, wind and in philosophy the soul (Deppert and Stoll, 1997).

The pressure required in the automation laboratory is 6 bar, with which pneumatic mechanisms such as electrovalves and pistons are worked; This proposal aims to automate a double-effect piston using a solenoid valve, sensors, push button normally open and a power supply of 24 volts direct current, where students will do the simulation with the software fluid-sim-p using the computer and air source equivalent to the required level of pressure.

The pressure is the magnitude that indicates how the force is distributed on the surface to which it is applied. P = F / A, where: F = Force, its unit is Newtons. A = Area, its unit is m2 and in the international system of units to N / m2 it is called pascal (Tippens, 2009).

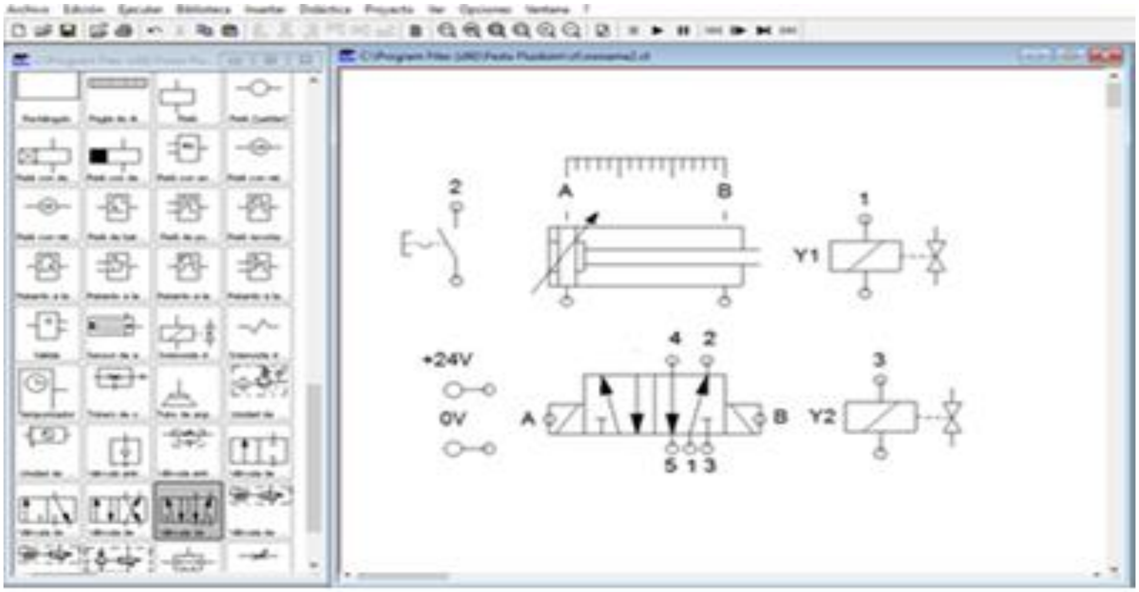
The application of the concept of pressure was made looking for the practical application where the student could link their previous knowledge with technology, using the help of simulation software Fluid-sim-p to demonstrate its operation and then check the result with compressed air to drive the piston by means of an electric control system to automate it.

This teaching is oriented by the content imparting information and transmitting structured knowledge, there is a continuous teacher-student interaction as a facilitator of the understanding of the topics seen. The time it would take to teach the subject of pressure is a two-hour class, based on previous knowledge. In addition, a practical demonstration of the subject is carried out in the respective laboratory with students of the second semester of the Mechatronics career.

In the specialty of Mechatronics students are expected to work what they learn in the classroom taking it to the laboratories, the institution has a computer lab exclusively for simulations and then the students are transferred to the automation area where they are done reference to industrial application relating theory to practice. Figure 1 shows the Fluid-sim-p software environment applied during the process.

In the process, we work with the software by dragging each of the components to the work area, paying attention to the problem where the pressure issue is included. The components that are involved in the automated process are: a five-way valve two positions, a normally open switch, a 24-volt DC power supply, two magnetic sensors, double-acting pistons, four-millimeter hoses to transport the air and an air distributor.

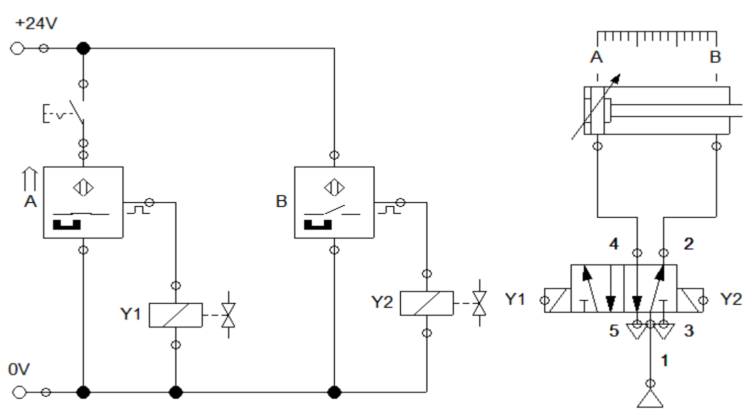
Figure 1. Software environment flud-sim-p.



Source: tomada del software fluid-sim- propiedad de Festo Didactic.

Next, the student is instructed to start making the pneumatic connections where pressure and electricity are involved in order to link the simulation with the reality of the process, in figure 2 the finished electro-pneumatic diagram is shown.

Figure 2. Electro-pneumatic diagram of the process.



Source: elaboración propia.

In the electro-pneumatic diagram made by the students with the Fluid-sim-p simulation software, the a priori operation of assembling the circuit in the profile plates located in the automation laboratory is verified, taking into account two things in the learning : cognitivism and behaviorism; Behaviorism deals fundamentally with motivation and avoids cognition; cognitivism focuses primarily on cognition, ignoring motivation (Hernández, 1991).

In this way in the first phase students are working applying their theoretical knowledge acquired in the classroom, to perform the simulation with the software flud-sim-p where they can verify their connection and exact operation by introducing the pressure in the electrovalve which it will send the pressure to the piston to be automated by the magnetic sensors, in this way the students stay motivated and when they have to do the real assembly they will have the clear and precise idea of cognition.

Then the students process the information from the acquired knowledge and solve the problem. "The subject that learns is no longer considered a passive information storage system, but rather as a self-determining agent that actively selects information from the perceived environment and builds new knowledge in the light of what it already knows" (Shuell, 1986).

The career of Higher University Technician in Mechatronics is made up of subjects distributed in five semesters. According to the educational plans of the fields of knowledge, the professional training that is provided to the students is according to the technical needs of the productive sector, the career of Mechatronics emphasizes the following disciplinary fields: mechanics, electronics, instrumentation, automation and robotics.

The first step was to analyze what characteristics should have the teaching-learning method applied in a theoretical-practical problem managing the computer and simulation software fluid-sim-p to specifically provoke the understanding of theoretical concepts and realacionarlos with practice in performance academic students, these characteristics are constituted by a series of mechanisms that imply the construction of knowledge.

During the delivery of the subject of Hydraulic and Pneumatic Systems, two groups of students were selected, one that received the classes in a traditional way and another was treated by the proposed teaching-learning method in which the use of the software fluid-sim-p and the computer. One group consists of 26 students and the second group consists of 25 students, who were tested to measure their academic performance.

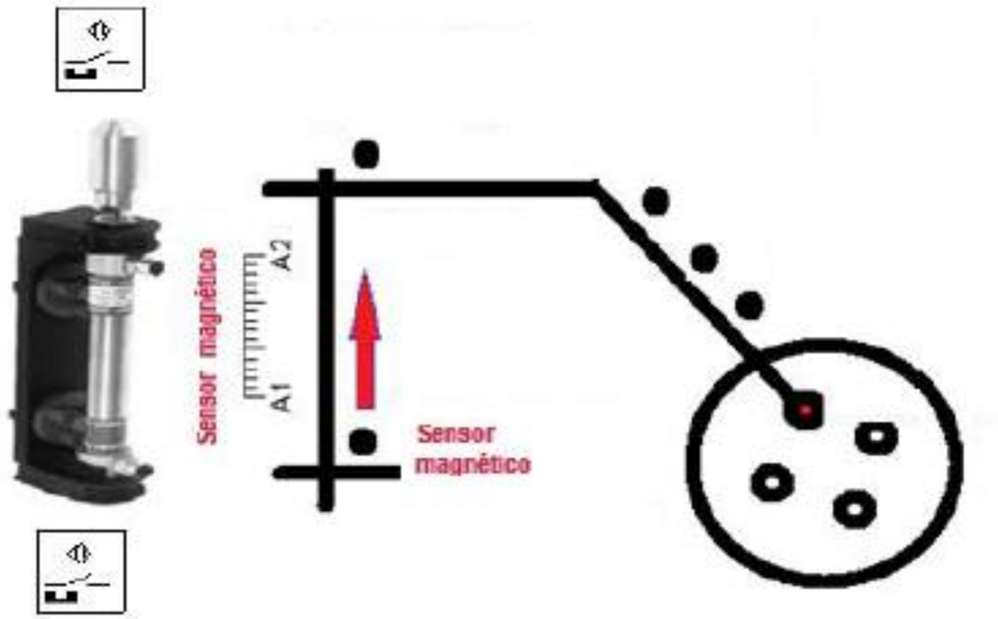
The evaluation instruments were applied to the two groups just after viewing the class contents and the results were measured, which constituted an increase in learning. The following month a second evaluation was applied, finding favorable results of compression and relationship of the theoretical with the practical, which served to measure the progress of utilization.

The understanding of the method was also evaluated independently at the end of the investigation, using computer and simulation software fluid-sim-p in the electropneumatic components, of course soo applied for students who had received this type of training. Below is the problem that was used as the first and second exam operated as an assessment tool in the academic performance of the students.

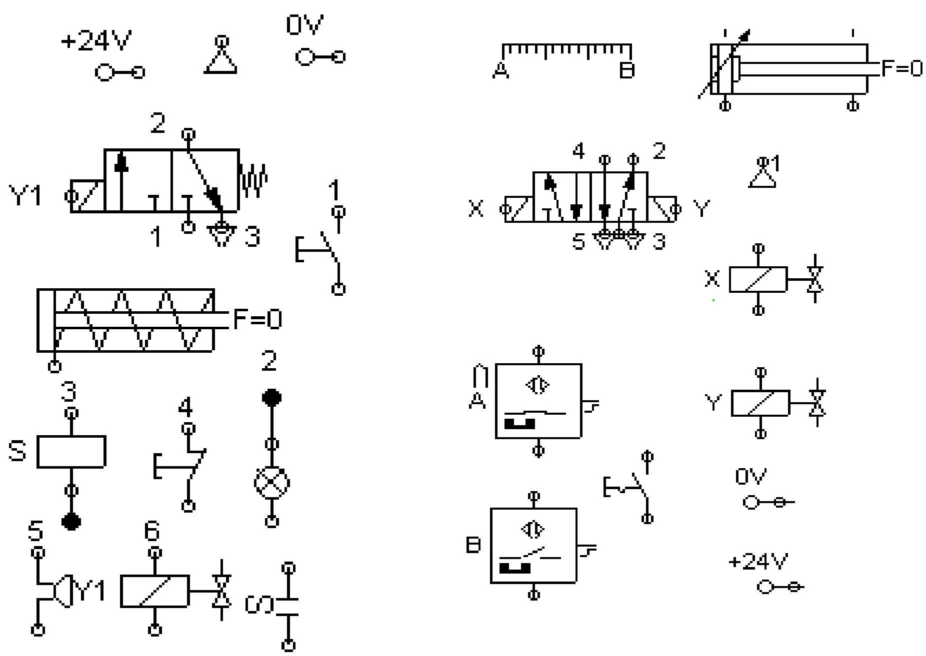
A conveyor elevator of metal parts with a double-acting piston is used. Pressing a button will automate the process by designing an electrical memory. When a second button is pressed, normally closed, the electrical memory will be disabled and the piston will return to its retracted stem position. Use the electrical pneumatic symbols shown in figure 3, to carry out the automation of the first examination with magnetic sensors and in figure 4 another automation with limit switches for the application of the second test is shown.

The indications for this test are the following: students must use their pneumatic and electrical knowledge to make the required connection, reaching to understand the concept of pressure, automation, connection of magnetic sensors, identification of normally open pushbutton, pushbutton normally closed, power supply, relays, lamps, selenoids and solenoid valves.

Figure 3. Symbols for automation with magnetic sensors.



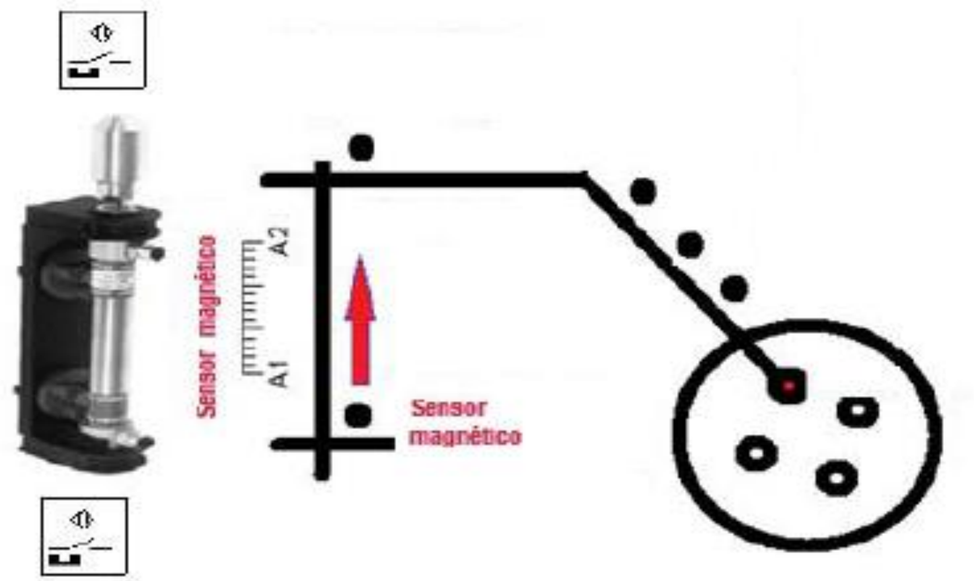
Source: elaboración propia.



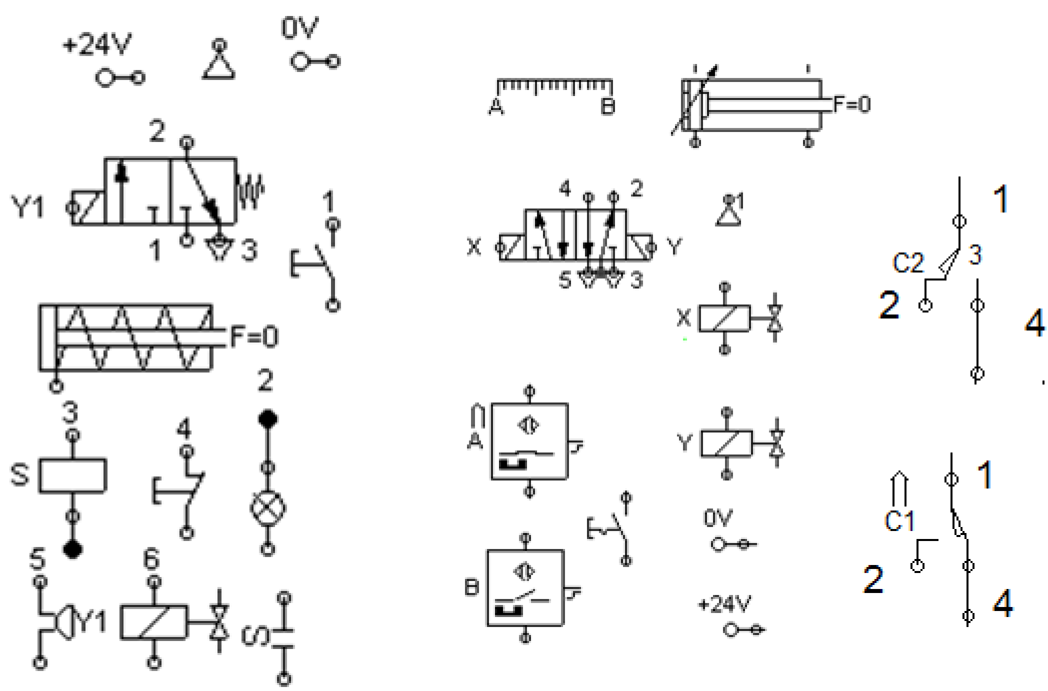
Source: símbolos tomados del software fluid-sim-propiedad de Festo Didactic.

The second test, which was used as an evaluation instrument, is shown where two end-of-stroke detector sensors were used instead of magnetic sensors.

Figure 4. Symbols for automation with end-of-stroke sensors.



Source: elaboración propia.



Source: símbolos tomados del software fluid-sim-propiedad de Festo Didactic.

Discussion

It was observed that the students who used the computer with software showed an outstanding performance, in which their abilities, at the time of acting, reflected the experience in solving the problems posed, establishing the familiarity in working a real system model taking it to the practice in assembling electropneumatic circuits, understanding the solution skillfully in the programmed test problems.

The programmed problems were established according to the study programs according to the needs of the productive sector, with a situational analysis of the work done by businessmen and teachers of the Technological University of Altamira, in which, by being part of higher education institutions , proposes in its careers programs that include the management of the computer and the use of certified softwares.

One of the strengths of the proposed method is that the suggested relationships not only allowed the student a better understanding of the proposed topic, but also led to work with skills that would allow students to relate theoretical concepts to practice and realize that they can solve any problem in a simulation environment, having the certainty that by taking it to the real it will exercise its function preventing accidents due to bad connection

The students who worked with the proposed method showed a greater interest in interacting with each of the components offered by the simulator as visual photographs of each electrical and electropneumatic element, detailing a priori the development of the problem as having the result of the simulation a completely different expectation was generated when supposing its ideal functioning with zero defect to the required need, improving the use.

The limitations that were presented were in terms of the time of application of the research that evaluated only students of one generation during a school period and that not all teachers who teach these subjects were willing to participate, so they worked with groups and established. On the other hand, a weakness is that it is not possible to avoid is the leakage of information, especially at a time when the development of information technologies has advanced so much and since it is an exercise that develops quickly this situation could have generated a certain bias in the results.

Conclusions

It is concluded by using the problem of pressure in electropneumatic systems with the proposed method, which awaken in students skills in the development of practices such as: safety when making direct connections of industrial application, teamwork is strengthened, shortening of shorts circuits and enthusiasm for working, because in this way there is a close relationship between the theories expounded by teachers and the real world that students face.

It was appreciated that the students, when they did this test, increased the academic performance in the field of hydraulic and pneumatic systems, because of teaching a theoretical class and going directly to the practices, biases were observed when applying their knowledge, however with the use of computer and simulation software improves their vision of doing things and reinforces the knowledge acquired in the classroom by relating the theoretical and practical.

The realization of the research in terms of their learning showed an improvement of the students in each one of the indicators shown in table 1, where the academic performance and the results of the groups are indicated: one is the traditional one and the second group indicates the reusltado with the application of the method.

Table 1. Indicador de desempeño académico primer examen.

Indicador de desempeño académico primer examen		
Grupo	**Comprensión de conceptos teóricos**	**Comprensión de conceptos prácticos**
A (método tradicional)	**67**	**52**
B (método propuesto)	**90**	**88**

Source: elaboración propia.

Table 1, column two, presents the results of the first examination concerning the understanding of theoretical concepts, method A (traditional), which shows the deductions of young people who have a vague idea in the application of the problem regarding the proposed topic , obtaining a result of 67 in the application of the test; with method B an improvement in the utilization was observed 90, fructifying the resources of the simulation software and the computer.

In table 1, column three, the indicator corresponding to the understanding of practical concepts, method A (traditional), the students did not reach the goal with learning, even they expressed doubts when making physical connections, obtaining a result of 52; using method B they understood the explanation explained by the teacher, relating it to the simulation software and they were able to make the physical connections without fear of committing a short circuit or damage to the equipment, obtaining an average of 88.

It is concluded that the use of technology in higher education schools is a great support for students, because when using simulation software users are allowed to modify parameters observing the reaction to changes produced using the computer in full capacity, predominating Experimental learning by discovery, in which the software designer creates nourished environments in a situation that the user must explore, until they reach knowledge based on an experience.

By working with the simulator fluid-sim-p through images and symbols the student's attention is captured, obtaining significant learning where the student knows and works in a virtual reality, discovering and developing skills that allow to increase their capacity to respond to the demands of media technology, differentiating and creating their own learning through direct experience in their area of specialization, narrowing gaps between academic theory and work practice.

In table 2, column two, the results of the second examination are indicated in relation to the theoretical concepts with the practical ones, method A (traditional), the students were worried and it is important to mention that the communication between the test groups A and B at some point could filter information through social networks, which generated almost similar results for group A (90) and B (92), however students who applied method B, were confident, dynamic, enjoyed the application of theoretical learning and practical application.

Table 2. Indicador de desempeño académico segundo examen

Indicador de desempeño académico segundo examen		
Grupo	**Relación de conceptos teóricos con prácticos**	**Comprensión del método con software y computadora**
A (método tradicional)	**90**	**No aplica**
B (método propuesto)	**92**	**94**

Source: elaboración propia.

In table 2 column three, understanding of the method with software and computer only applies to method B where the results were very favorable, since the students got used to doing any problem proposed with the tools: computer and simulation software, being able to do the entertaining and dynamic learning generating an atmosphere of confidence and security when managing the equipment, the results obtained in the exam were 94.

With the aforementioned results it is concluded that the students in the field of hydraulic and pneumatic systems decreased the failure rate with the intervention of the computer and simulation software in the Technological University of Altamira.

Bibliography

Carr, D. (2008). Learning in Virtual Worlds for inclusion. Education 2.0. A commentary by the Technology Enhaced Learning phase of the Teaching and Learning Reserach Programme, TLRP. Ed. Selwyn, pp. 17-22.

Deppert, W., Stoll, K. (1977). Aplicaciones de la Neumática. Marcombo - Boixareu Editores.

Hernández, P. (1991). Psicología de la Educación: Corrientes actuales y teorías aplicadas. México: Trillas.

Lévy, P. (2007).Cibercultura. La cultura digital de la sociedad digital. Barcelona.Anthropos

Manovich,L. (2005). El lenguaje de los nuevos medios de comunicación. La imagen en la era digital. Barcelona: Paidós.

Tippens P.(2009). Física Conceptos y Aplicaciones (8a ed.). México, Distrito Federal: McGraw-Hill, pp. 328-329.

Real Academia de la Lengua Española [RAE]. (2017). Consultado el 3/06/2017 del website: http://dle.rae.es/=diccionario

Shannon, R y Johannes, J. D. (1976).Systems simulation: the art and science. *IEEE Transactions on Systems, Man and Cybernetics*. 6(10). pp. 723-724.

Shuell, T. J. (1986). Cognitive conceptions oflearning. Review of Educational Research, 56, pp 411-436, doi:.org/10.31002/00346543056004411

Turkle, S. (1997). La vida en la pantalla. La construcción de la identidad en la era de internet. Barcelona: Paidós.

Universidad Tecnológica de Altamira[UTA].(2017).Consultado el 7/jun/2017 de: http://www.utaltamira.edu.mx/

Virilio, P. *(1989). War and cinema. Londres: Verso.*

Rol de Contribución	Autor(es)
Conceptualización	**Edgar Uxmal**
Metodología	**Edgar Uxmal**
Software	**Edgar Uxmal**
Validación	**Edgar Uxmal**
Análisis Formal	**Edgar Uxmal**
Investigación	**Edgar Uxmal**
Recursos	**Edgar Uxmal**
Curación de datos	**Edgar Uxmal**
Escritura - Preparación del borrador original	**Edgar Uxmal y Genaro**
Escritura - Revisión y edición	**Edgar Uxmal**
Visualización	**Edgar Uxmal**
Supervisión	**Edgar Uxmal**
Administración de Proyectos	**Edgar Uxmal**
Adquisición de fondos	**José Luis**