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In the first article we present, *Installation, control and automation of Carrier line*, by MORALES-IBARRA, Vanessa Maribel, MARTINEZ-AGUILAR, Gloria Mónica, VALENZUELA-LOERA, Carlos Manuel and SOSA-ESCOBEDO, Abel, with adscription in the Universidad Tecnológica de Torreón, as next article we present, *Downtime reduction in ventilation hole cutting operation in steel wheel stamping*, by GARCÍA-CASTILLO, Ilse Nallely, GUEL-GONZÁLEZ, María Isabel, NIETO-SALDAÑA, Nelly del Carmen and ZAPATA-HERRERA, Juan Manuel, with adscription in the Universidad Tecnológica de San Luis Potosí, as next article we present, *Industry 4.0 and the digital transformation… A new challenge for higher education*, by MARTÍNEZ-BAHENA, Elizabeth, CAMPOS-PEREZ, Alfredo Emmanuel and ESCAMILLA-REGIS, Daisy, with adscription in the Tecnológico de Estudios Superiores de Cuautitlán Izcalli, as next article we present, *Using the Edpuzzle tool for teaching programming logic in higher education*, by TOLANO-GUTIÉRREZ, Helga Karina, AMAVIZCA-VALDEZ, Laura Olivia, PORTELA-PEÑÚÑURI, Luis Tadeo and GÁMEZ-WENDLANDT, Julio César, with adscription in the Universidad Tecnológica del Sur de Sonora.

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Installation, control and automation of Carrier line

Instalación, control y automatización de línea Carrier

MORALES-IBARRA, Vanessa Maribel†*, MARTINEZ-AGUILAR, Gloria Mónica, VALENZUELA-LOERA, Carlos Manuel and SOSA-ESCOBEDO, Abel

Universidad Tecnológica de Torreón

ID 1st Author: *Vanessa Maribel., Morales-Ibarra* / **ORC ID:** 0000-0003-3764-8858, **Researcher ID Thomson:** F-5287-2018, **CVU CONACYT ID**: 387893

ID 1st Coauthor: *Gloria Mónica, Martinez-Aguilar* / **ORC ID:** 0000-0003-3834-4880, **Researcher ID Thomson:** G-3878-2018, **CVU CONACYT ID:** 213558

ID 2nd Coauthor: *Carlos Manuel, Valenzuela-Loera* / **ORC ID**: 0000-0002-9176-7893, **Researcher ID Thomson:** X-9536-2019

ID 3rd Coauthor: *Abel, Sosa-Escobedo* / **ORC ID**: 0000-0002-4236-326X, **Researcher ID Thomson**: X-9775-2019, **CVU CONACYT ID:** 504973

Abstract

For centuries, humans have attempted to improve their living conditions, seeking to facilitate their daily tasks and in the industry, seeking to improve production processes, in order to be more competitive and generate greater wealth through their work, trying to avoid work risks and accidents, improve product quality and production times, as well as downtime. The design proposed for this work is that of a roller conveyor by gravity, controlled and monitored by PLC, sensors, dosers, and data matrix cameras, in order to have internal control of the manufacturing process of the Carrier piece. The automation of this conveyor line will reduce transport times between each work operation, eliminating unnecessary movements and increasing mobility in each work operation. This will help increase production, in addition to reducing mishandling of the piece caused by the wrong manipulation of the operator.

Automation, Control, Production line

Resumen

A través de los siglos el hombre se ha propuesto mejorar sus condiciones de vida, buscando facilitar sus labores cotidianas y en la industria buscando mejorar los procesos de producción, con el fin de ser más competitivo y generar mayor riqueza atreves de su trabajo, buscando evitar riesgos de trabajo, accidentes laborales, mejorar su calidad en el producto y tiempos de producción, así como tiempos muertos. La propuesta del diseño de este trabajo es la de una transportadora de rodillos por gravedad, controlado y monitoreado por PLC, sensores, dosificadores, cámaras data matrix, para así tener un control interno del proceso de fabricación de la pieza Carrier. La automatización de esta línea transportadora reducirá los tiempos de transporte entre cada operación de trabajo, eliminando los movimientos innecesarios y aumentando la movilidad en cada operación de trabajo, esto ayudará a aumentar la producción, además de reducir el maltrato de la pieza producido por el mal manejo del operador.

Automatización, Control, Línea de producción

* Correspondence to Author (email: vmorales@utt.edu.mx)
† Researcher contributing first author.

Article

Introduction

Industrial automation

Industrial automation is the application of different technologies to control and monitor a process, machine or device that usually performs repetitive functions or tasks, causing it to operate automatically, minimizing human intervention. What is sought with industrial automation is to generate as much product as possible in the shortest possible time, in order to reduce costs and ensure quality uniformity.

There are different types of automation and, based on the needs of the process to automate, the corresponding automation will be designed. The different types of automation are mentioned below:

- Fixed automation.
- Programmable automation.
- Flexible automation.
- Integrated automation.

Material handling

The handling of materials and products can be defined as the preparation and placement of each of them to facilitate their movement within an industrial process. It includes all the operations to which the product is subjected, except the actual manufacturing work and, many times, the handling of materials and products is included as an integral part of the process.

Nowadays, there has benn a special interest in the mechanical transport of materials and products because the workforce is increasingly expensive and, at the same time, dangerous, depending on the process.

By using mechanical means to transport materials and products, safety is greater, with less risk of accidents, they do a more arduous work and at the same time they are faster and more efficient.

For industrial processes that include assembly or transfer lines of materials or products, the use of a mechanical transport system is essential. In most of them, roller belts or conveyors are used, as it is in this case.

This is due to several advantages that they present, such as the great distances they can transport products, ease of adaptation to the land or architecture of the process within the plant, their great transport capacity, the availability to transport various materials and products, and they do not alter the transported product. With time, conveyor belts have evolved their construction, design and operation according to the needs and characteristics of the production processes. There are different types of conveyor belts and they are classified based on their type of conveyor:

- Free roller conveyor

The roller conveyor is the most versatile gravity system. As the name implies, it uses metal rollers to facilitate the handling and transfer of a wide variety of products (boxes, parcels, packages, tires, pallets, barrels, etc.)

- Skate wheel conveyor

This system is used to transport light packages with a soft and irregular bottom. Ideal for off-loading trucks. The wheels are galvanized to resist corrosion.

- Flexible roller conveyor

Lightweight and portable, it is the first option for transporting materials with a regular surface and considerable weight. Used in loading and unloading trucks, packing lines, inspection and product dispatch. Unlike skate wheel conveyors, this type of equipment cannot handle products that exceed the width of the roller. These conveyors can move any product with a uniform surface such as boxes, packages, containers, etc.

- Flexible skate wheel conveyor

It is the first option for materials with an uneven base or moderate weight. These conveyors can move boxes, trays, wooden and metal bases of various sizes. Excellent alignment characteristics which prevent lateral sliding and reducing the need to use side guard.

- Ball transfer conveyor.

This omnidirectional system, allows moving the load with little force on the surface of the conveyor.

Used when manual rotation or correct positioning of a product in assembly, revision and control lines is required. Ideal for times when two production lines converge, with the condition that the item to be handled has a regular and firm base.

Types of sensors

A sensor is basically a device that has the power to detect movement, noise, pressure, light and any other type of external element to convert it into an electrical signal. It is possible that the same equipment has different types of sensors for each operating unit. A sensor is a device which has the property of being sensitive to a magnitude of the surrounding environment, if this magnitude varies, the property also varies with some intensity, that is, it manifests the presence of said magnitude and also its measurement. There are different types of sensors and a common way to classify them is based on the digital and analog output data; they are used to develop physical interfaces, robotic systems, etc.

Some of the most commonly used sensors are:

- Photoelectric sensors.
- Inductive proximity sensors.
- Ultrasonic sensors.
- Capacitive proximity sensors.

During the development of this work, photoelectric sensors were used. These helped to detect the absence and presence of the carrier piece within the process.

Pneumatic system

For this work, the movement of the piece was carried out by means of pneumatic pistons installed inside the conveyor line. Pneumatic circuits are circuits aimed at providing the automatic drive of a device by means of a pressurized fluid (air). The pneumatic circuits use compressed air, because air is abundant, it can be stored and it is clean. The applications of the pneumatic circuits are varied, like the closing and opening of doors of trains and buses, vehicle brakes, operation of machines and tools, etc.

- Programmable logic controllers

For the selection of the Programmable Logic Controller, it is necessary to define which are the input and output signals as well as the characteristics that will be used in the operation of the conveyor. A programmable logic controller PLC is an application-specific microprocessor for industrial process control. A PLC is a control unit which includes all or part of the interfaces and/or sensors of the process, the current trend to control them is to use them in a network or as peripherals of a computer, where the computing power is combined with the ease of standard interfaces offered by the PLC.

Work development

The company made a line balance, where we identified that to increase production it was necessary to reduce transport times and relocate operations, since the transport of the piece between station and workstation was done manually. The development of this work was carried out with the traditional methodology, together with the agile methodology in the programming design part. It was necessary to implement gravity roller conveyor systems through the production line, an automation system was implemented in each of its operations, placing sensors, dosers, data-matrix cameras at midpoints of the operations, PLCs (Programmable Logic Controllers), in order to have an internal control of each step of the process, of each of its 16 operations, and thus control the path in the process. This system will greatly reduce the manufacturing time of the piece and save money during the machining, assembly and welding of the piece to be manufactured.

This work was designed based on the spaces available within the plant, using a roller conveyor and proposing different systems within it: a motion transmission system, an electro-pneumatic system and a control system governed by PLCs with sensors.

This design was made based on the characteristics and needs of the production line obtained by a physical survey in the panta, with the reliability that the production process of the carrier piece was already clearly known and with its possible modifications, if they were required in this production plant or in any other.

Methodology

Motion transmission system

For the mechanical design of the roller conveyor, the total dimensions of the Carrier line were taken into account first, based on this, all the mechanical diagrams were designed, such as the mechanical structure recquired for the conveyor, including its bases and the separation suitable between rollers. According to the given dimensions of the Carrier line, the mechanical diagrams were designed; for this step, we analyzed the movement of the piece for its correct manufacture, creating a correct installation of the conveyor line.

Figure 1 shows the diagrams that were made for the manufacture of the conveyors with their respective dimensions.
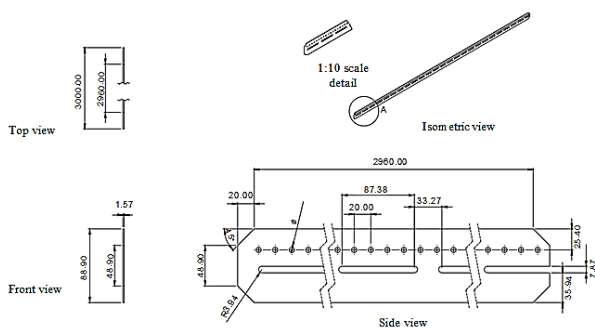
Figure 1 Mechanical diagram of the roller conveyor
Source: Prepared by the authors

Figure 2 shows part of the mechanical design of the roller conveyor, where the parts of its design are specified. The figure is complemented with table 1.
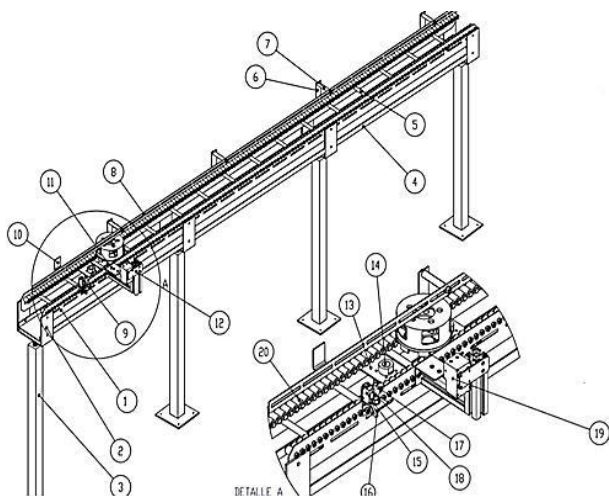
Figure 2 Scale diagram of mechanical components
Source: Prepared by the authors

No. of element	No. of piece
1	Laterals
2	Lateral supports
3	Support - legs
4	Burr
5	Lateral separator
6	Guide shaft support
7	Guide shaft
8	Guide
9	LR-2B100N sensor base
10	R-5 Reflector Base
11	Aluminum outline base
12	SR-1000 Base
13	RSQB32-20D stop base
14	RSQB32-20D
15	LR-ZB100N_ZB100P
16	OP-87404_Bracket
17	OP-87405_Bracket
18	OP-87406_870407_Bolt
19	SR-1000
20	Roller

Table 1 Conveyor mechanical design components
Source: Prepared by the authors

Electro-pneumatic system

For the installation of the pneumatic pistons, the conveyors were designed with base slots for the installation, which is where the pistons are mounted on the lateral bases of the conveyor; the slot was placed so that it could be adjusted in some future or with some modification. Figure 3 shows the mechanical design of the base for the assembly of the pistons.
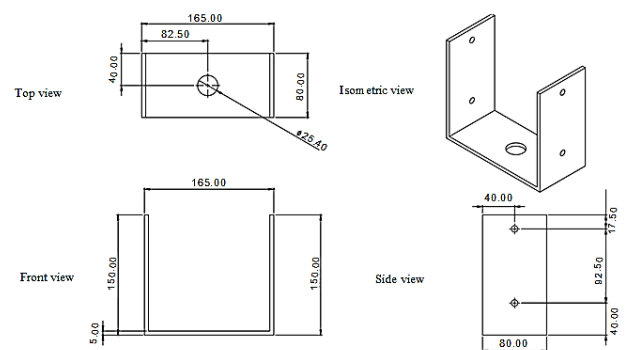
Figure 3 Base for pneumatic pistons
Source: Prepared by the authors

Figure 4 shows the pneumatic piston assembly diagram used in the conveyor belt.
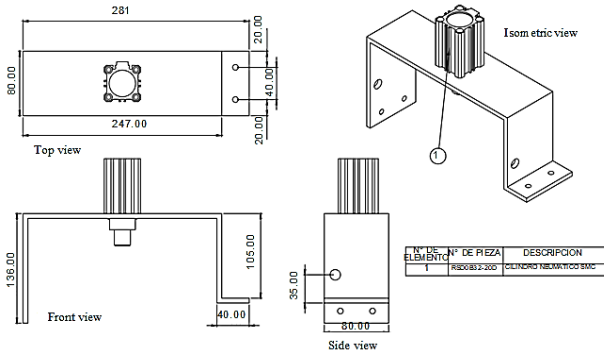
Figure 4 Assembly diagram of pneumatic pistons
Source: Prepared by the authors

Figure 5 shows the design for the lifting pistons that are required in some of the process stations.
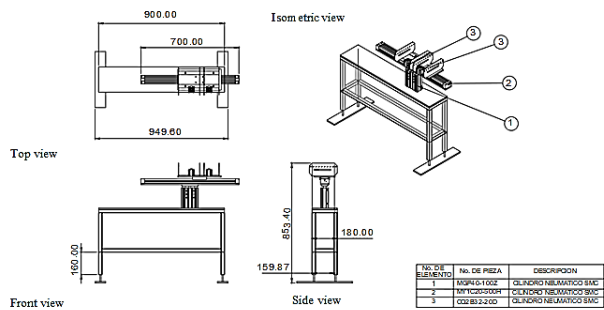
Figure 5 Mechanical diagram of lifting pistons
Source: Prepared by the authors

Control system

The programming is ladder type; Figure 10 shows part of the program used within the automation of the Carrier line conveyor belt.

The main function of this automation is to have an internal control of each operation. Since within each of the operations Data-matrix sensors and detection cameras will be placed in each piece, this system is implemented at the entrance and exit of the operation, in order to detect in time the exact movements of the pieces; in case of having lost pieces, the company will be able to detect them in time from a computer, where it will receive all the exact information of each piece. In order to implement this, a database was created where this information will be collected; in the control cabinets the PLCs are mounted.

To carry out the automation process between each operation, Allen Bradley Micrologix 1200 PLCs were installed. These PLCs were selected to take full advantage of the proposed programming and implementation.

For the installation and commissioning of the PLCs, physical arrangements were designed within the assigned available work area that was assigned, using the SolidWorks program; with the help of the program and taking into account the space allocated for each cabinet, we carried out the measurements of the spaces to design the physical arrangement at scale. Figure 7 shows the general connection diagram of the source.
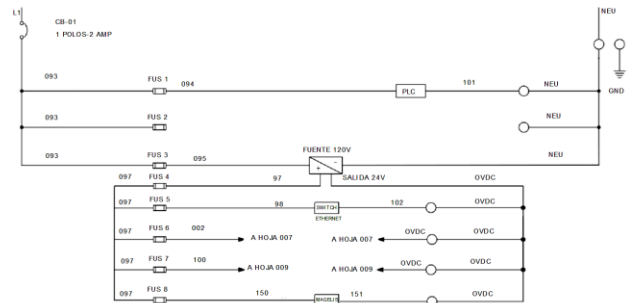
Figure 6 General connection diagram design
Source: Prepared by the authors

Results

The results of each part of the development of this work are shown below.

Motion transmission system

One of the main objectives of this work was to optimize through a conveyor belt the travel times of the manufacturing process of the Carrier line; in figure 8 we can see part of the installed conveyor belt.

Figure 7 Conveyor Belt Installation
Source: Prepared by the authors

Electro-pneumatic system

The electro-pneumatic system designed for the different fixed and rotating cylinders can be seen in Figure 8 and 9, showing the results obtained.
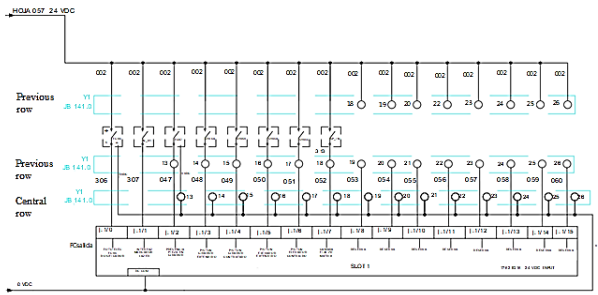
Figure 8 Connection diagram of the rotating piston, chamber, presence sensor
Source: Prepared by the authors
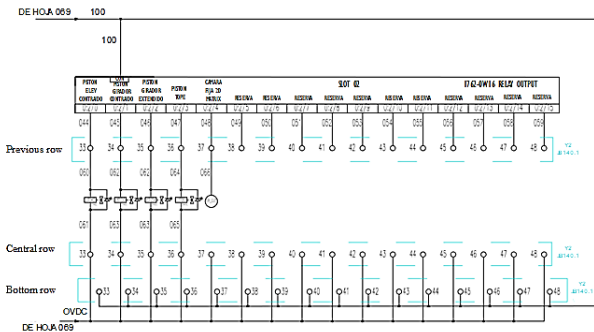
Figure 9 Electric diagram of stop piston, extended spinner, contracted spinner
Source: Prepared by the authors

Control system

We used ladder programming for the development of the program applied in this work; part of the program is shown in Figure 10.
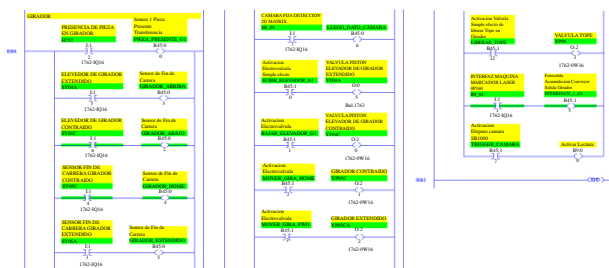
Figure 10 Ladder program, Carrier line conveyor
Source: Prepared by the authors

Acknowledgments

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Conclusions

The results obtained were those desired during the work proposal and the design of automation and operation of the conveyor belt.

The system provides information on the location of the piece, showing in which station it is located for its machining, as well as the progress within the manufacturing process; thus, offering better time control and machining of the piece.

An area of opportunity of the system is the creation of automation subsystems where the process can be handled in a modular way, for any events of failure in any of the 16 workstations through which the piece is transported.

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Downtime reduction in ventilation hole cutting operation in steel wheel stamping

Reducción de tiempos muertos en operación de corte de agujeros de ventilación, en estampado de rines de acero

GARCÍA-CASTILLO, Ilse Nallely†*, GUEL-GONZÁLEZ, María Isabel, NIETO-SALDAÑA, Nelly del Carmen and ZAPATA-HERRERA, Juan Manuel

Universidad Tecnológica de San Luis Potosí, Industrial Division; Av. Dr. Arturo Nava Jaimes 100; Rancho Nuevo, San Luis Potosí. C.P.78430

ID 1st Author: *Ilse Nallely, Garcia-Castillo* / **ORC ID:** 0000-0001-9602-2869, a**rXiv Author ID:** IlseGarcia, **CVU CONACYT ID:** 668657

ID 1st Coauthor: *María Isabel, Guel-Gonzalez* / **ORC ID:** 0000-0003-2678-1215, **CVU CONAYCT ID:** 474826

ID 2nd Coauthor: *Nelly del Carmen, Nieto-Saldaña* / **ORC ID:** 0000-0002-3100-7139

ID 3rd Coauthor: *Juan Manuel, Zapata-Herrera* / **ORC ID:** 0000-0003-4034-9891, **arXiv Author ID:** juan280466

Abstract

A company's productivity improvement is multi-causal, one of the causes being the reduction of time. That is why this article presents the methodology that a transnational automotive company performs to reduce downtime in the ventilation hole cutting operation, since it is a critical process that directly affects the productivity of the company. This project was carried out with the DMAIC methodology, in which the diagnosis is made through Ishikawa and Pareto, continuing the analysis of time. As part of the analysis of downtimes, the most frequent failures are included, as well as preventive maintenance and specifically tooling. Information is presented regarding the areas of opportunity, implementation of improvement strategies delimited by the design of an awl. Finally, it shows the reduction of time in the change of tooling, through the implementation of the improvements.

Resumen

La mejora de productividad de una empresa es multicausal, una de estas causas es la reducción de tiempos es por ello que en éste artículo se presenta la metodología realizada en una empresa transnacional de giro automotriz para reducir los tiempos muertos en operación de corte de agujero de ventilación, dado que es un proceso crítico que afecta directamente la productividad de la empresa. Este proyecto se realizó con la metodología DMAIC, donde se realiza la diagnosis a través de Ishikawa y Pareto continuando con el análisis de tiempos. Como parte del análisis de los tiempos muertos incluye las fallas más frecuentes, así como los mantenimientos preventivos y específicamente los herramentales. Se presenta la información respecto a las áreas de oportunidad, implementación de estrategias de mejora delimitadas por el diseño de un punzón. Por último se muestra la reducción del tiempo en el cambio de herramental, a través de la implementación de las mejoras.

Improvement, Lean Manufacturing, Downtime

Mejora, Manufactura esbelta, Tiempos muertos

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* Correspondence to author (email: igarcia@utslp.edu.mx)
† Researcher contributing as first author.

Introduction

In any company, it is necessary to implement strategies which contribute to the decrease or, in the best case scenario, to the elimination of downtime and subsequently to the increase in productivity (Estañol, 2000).

Increase in downtime in the operation of ventilation hole cuts in steel wheel stamping started in January 2017, so there was a need to reduce these times since it is one of the most critic obstacles within the productive process.

Lean Manufacturing tools (D., 1986) are used, such as: 5 why's and Ishikawa and Pareto Diagrams. Downtimes and the history of preventive maintenance are analyzed and more frequent failures are collected to rule out problems in tooling and the possibility that these generate technical stops that affect productivity. Improvements are developed and applied in an awl, since it is the main component of the tooling that causes reduction in time.

Method Description

The problem is addressed through the DMAIC methodology, acronym for the steps: Define, Measure, Analyze, Improve and Control. It is a quality strategy based on statistics, which gives primary importance to the collection of information and the veracity of the data as a basis for the incremental improvement of existing processes (Fraile, 2002).

1. **Define:** Initial phase of the methodology, the objective of this stage is to identify the possibilities of improvement within the company through the SIPOC analysis (Feigenbaum, 1961).

Graph 1 SIPOC Methodology
Source: (Maxwel Company Notes, Unpublished)

2. **Measure:** Once the problem to be addressed is defined, data are collected on the main failures that occur in the process of manufacturing disks, with the purpose of learning the cause that generates more downime and how many times the same fault is repeated.

Failure report January 2017				
Date	Cause	Frequency (No. of interventions)	(time/min)	Accumulated %
Jan-05-17	Change of awls for wear or breakage	6	45	22%
Jan-11-17	Material removal in guide holes	4	10	37%
Jan-16-17	Oscillation problems	3	35	48%
Jan-18-17	Sensor for detecting damaged parts	2	30	56%
Jan-18-17	Problems with overload	2	22	63%
Jan-21-17	Problems with poka yoke parameters	2	20	70%
Jan-23-17	Outdated stamp	2	20	78%
Jan-24-17	Damaged hoses	1	15	81%
Jan-24-17	Pneumatic type failures	1	14	85%
Jan-25-17	Stripes on bottom disk	1	12	89%
Jan-25-17	Damaged bayonet sensor	1	10	93%
Jan-28-17	Piece out of position	1	10	96%
Jan-29-17	Poka yoke system failures	1	10	100%

Table 1 Failure Report
Source: (Project Notes, Unpublished)

A Pareto Diagram was implemented to determine the main problems within the process; 20% are concentrated in the first 7 causes, which have a total of 21 interventions in the month of January. Of these, the one with the longest downtime is "change of awls for wear or breakage," with 6 of the 21 interventions mentioned above.

Graph 3 Ishikawa Diagram
Source: (Project Notes, Unpublished)

3.   **Analyze**: After the Ishikawa diagram, a verification sheet was created with the sub-causes, where we indicate the frequency of each problem.

Subsequently, once the highest frequency was obtained, the corrective actions to follow were determined with the technique of the 5 Why's, making the decision to manufacture awl holders and awls.

Problem definition and 5 Why's			
Issue date	02/02/2017	Person in charge	José Carlos Hernández
Área	Production	Support Area	Tool Department
1. Defining the problem			
What is the problem?	Awls with dimensions outside the specification		
Where is the problem located?	In the tools for cutting ventilation holes	Who detected it?	The Tool Department
How was it detected?	When validating the measures according to design	Where was it detected?	25/02/2017
2. Quantifying the problem			
How many pieces were stopped from producing?	450	How often?	6 times in a month with a time of 45 min

Graph 2 Pareto Chart
Source: (Project Notes, Unpublished)

After obtaining the main approach that affects the process of manufacturing disks, a cause and effect diagram was implemented. It is a diagram that helps us delve deeper into the problem using the 6M method (Guillen, 2012).

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3. Identifying the root cause				
Identifying the root cause		Corrective actions	Person in charge	Term
Why is the awl out of specification?	Because the supplier manufactured the awls with larger dimensions	Review of the upper part of the tooling and look for an improvement idea in the awls	Tool Department	1 month
Why did the supplier manufacture the awls with larger dimensions?	Because the dimensions in the awl socket are different			
Why are the dimensions of the awl socket different?	Because they are not standardized in the measurements of the socket upper part			
Why are they not standardized in the measurements of the top socket?	Because there is no fixed awl holder inside the tool socket			

Table 2 Analysis of 5 Why's
Source: (Project Notes, Unpublished)

4. **Improve**: While changing the component, it is sized according to the design due to the variation of the dimensions in the sockets of the upper part of the tooling and a rework is performed on the flat surfaces of the awl, enabling the placement of the component without difficulty.

The plan of awl improvement consists in making the manufacture of two components which are: awl and awl holder; when performing the awl change, the action will be carried out with single-dimension hand tools, avoiding an accident, so that the tool technician can solve the problem in the fastest way.
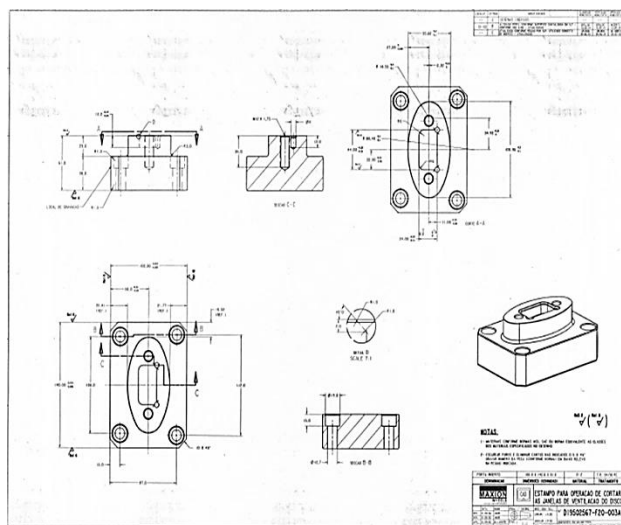
Figure 1 Tooling Design
Source: (Project notes in Maxion Company, Unpublished)

5. **Control:** In this phase, we validate, verify and monitor the improvement, in order to detect any recurrence and to correct it in time. A diagram of process control is implemented to help us identify possible instabilities and abnormal circumstances.
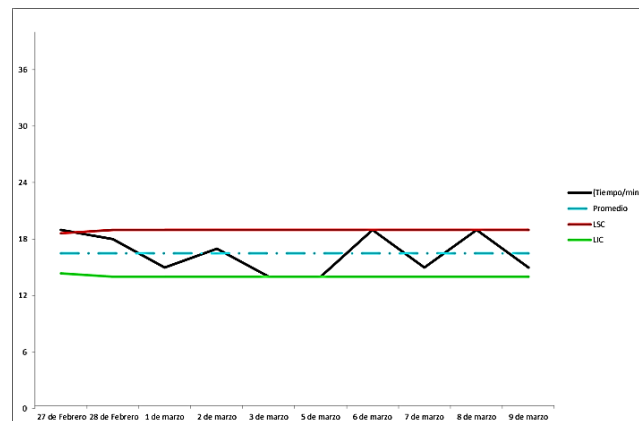
Graph 4 Process Control Diagram
Source: (Project Notes, Unpublished)

Results

The approximate time to make the change of a component is 40 minutes; with the implemented improvement, a 62.5.5% reduction in downtime was obtained, since the change is made in 25 minutes.

The improvement had a great positive impact, since at the time of changing the awl, an additional component called ironer had to be extracted, with an approximate weight of 20 kg.

After implementing the improvements, the extraction of the ironer will be avoided, thus reducing accidents and generating saving to the company.

Acknowledgments

Conclusions

Within each phase of the applied methodology (DMAIC), we can observe the contribution of quality tools, which enhances a better control in the process, resulting in an improvement in service quality. Achieving the objective of reducing tool change times; by decreasing the time, safety improves, man-time is saved, among other benefits.

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Industry 4.0 and the digital transformation… A new challenge for higher education

La Industria 4.0 y la transformación digital…. Un nuevo reto para la educación superior

MARTÍNEZ-BAHENA, Elizabeth*†, CAMPOS-PEREZ, Alfredo Emmanuel and ESCAMILLA-REGIS, Daisy

Tecnológico de Estudios Superiores de Cuautitlán Izcalli

ID 1st Author: *Elizabeth, Martínez-Bahena* / **CVU CONACYT ID**: 811086

ID 1st Author: *Alfredo Emmanuel, Campos-Perez* /

ID 2nd Coauthor: *Daisy, Escamilla-Regis* / **CVU CONACYT ID**: 650408

Abstract

It is important to realize that within everything that surrounds us, progress and innovation, it is being forced, we are obliged to be part of generating significant changes in the way of doing things, and the sooner we get involved, the better prepared we are. we will be there to know and apply this knowledge; education must be an integral part of this change, promoting attitudes and skills in students that allow them to be part of this new revolution, preparing them for better job, professional and personal opportunities. Objectives, methodology: Through this research, we seek to demonstrate that at present, all the technological resources that are available to us, brings as a consequence, a mandatory change in the way we see education, therefore, it is important to highlight that educational improvements are the that more are involved in making adjustments in the systems of knowledge delivery, involving different actors not only at the institutional level, but also in the productive sectors where there is an improvement in the processes that are managed and developed there; this in order to generate continuous improvements. Contribution: This research, aims to demonstrate that the implementation of the various technological tools will allow students to be better prepared when entering their professional life, in addition, will provide them with current elements to generate procedures that improve the management of information and production, applicable in various functional areas of any organization. If we try to generate an inclusive education, focused on managing the processes that every organization already manages, we will be forming significant changes in students, improving their study habits and working in advance to train better professionals focused on continuous improvement

Industry 4.0, integral education, technological tools, process

Resumen

Es importante darsenos cuenta que dentro de todo lo que nos rodea, los avances y la innovación, se esta obligandoestamos obligados a formar parte para generar cambios significativos en la manera de hacer las cosas, y mientras más pronto se involucrennos involucremos,, mejor preparados se estará estaremos para conocer y aplicar dichos conocimientos; la educación debe formar parte integral en dicho cambio, promoviendo actitudes y aptitudes en los educandos que les permitan ser parte de esta nueva revolución, preparándolos para mejores oportunidades laborales, profesionales y personales. Objetivos, metodología: Mediante esta investigación, se busca buscamos demostrardemostrar que en la actualidad, todos los recursos tecnológicos que se encuentran a nuestra disposición, trae como consecuencia, un cambio obligatorio en la forma que se vemos la educación, por ello, es importante destacar que las mejoras educativas, son las que más se ven involucradas en realizar adecuaciones en los sistemas de impartición de conocimiento, involucrando diferentes actores no solo a nivel institucional, sino también en los sectores productivos donde se dá una mejora en los procesos que ahí se gestionan y desarrollan; esto con el fin de generar mejoras contínuas. Contribución: Esta investigación, pretende demostrar que la implementación de las diversas herramientas tecnológicas permitirá a los alumnos estar mejor preparados al momento de ingresar a su vida profesional, además, los dotará de elementos actuales para generar procedimientos que mejoren la gestión de la información y producción, aplicables en diversas áreas funcionales de cualquier organización. Si se trata tratamos de generar una educación incluyente, enfocada a manejar los procesos que toda organización ya maneja, se estaraestaremos formando cambios significativos en los alumnos, mejorando sus hábitos de estudio y trabajando anticipadamente para formar mejores profesionistas enfocados a una mejora contínua.

Industria 4.0, educación integral, herramientas tecnológicas, proceso

* Correspondence to author (email: azuri9404@gmail.com)
† Researcher contributing first author.

Introduction

Currently, talking about technology implies that all aspects of everyday life are immersed in it, so it is that around us there are devices and devices that remind us of the importance of always being connected, and not only because of the ease of Be aware of what happens to us, but also because everything we do today, implies access to a resource or technological tool. One of the most important resources of any organization, lies in the importance of the way in which information is managed, making time to optimize decisions and generating processes that improve in time and form the activities that every company can carry out.

The productive order that is currently managed in all organizations, drives new processes to carry out all the tasks that are managed there, which is why it is vital that it is encouraged from the grassroots, the inclusion of systems that can give the knowledge of the students and in this way begin to change the way in which education is carried out in the classroom.It must be emphasized that the requirements have changed in the professional sector and it is a fact that we cannot continue providing education under the same guidelines.

It should be noted that education must be modified to adapt it to the new requirements of society, the challenge is: How to carry it out? Obviously, one of the levels where this process is vital, is the superior, since students It emerges directly to the labor sector, so it must be considered suitable and have its own tools to develop the activities that are requested in the best way and with the level of quality required;

That is why the role that teachers and educational institutions should take must be recognized, since this change will be carried out successfully to be based on their actions and the updates generated in the educational plans. One of the ways to carry out this change is to include project-based educational models, which will generate in the student the capacity for critical development to be able to implement knowledge in the solution to real situations that occur in the day to day in any organization.The pillars included in Industry 4.0 will also be reviewed and the way in which they can be approached to include them and make them known in the classrooms, thereby carrying out real actions that can enhance knowledge.

The central hypothesis that is managed lies in the fact that it demonstrates that, if adjustments to the curricula are included so that new ways of dealing with information focused on the management of projects and real problems of today's society can be implemented, they can be generated new forms of critical and abstract thinking to deal with labor aspects, capable of allowing solutions to optimize resources, supporting sustainability models, necessary in today's world.

In addition to this maelstrom of current events, it is very important that teachers have adequate training, according to their area of expertise to be able to correctly support the requirements that at the labor level should be considered as a basis in the formation of the development of new processes that are significant in the professional.

What is Industry 4.0?

It consists of the digitalization of industrial processes through the interaction of artificial intelligence with machines and the optimization of resources focused on the creation of effective commercial methodologies. (Logicbus, 2019)

One of the main ways to generate economic development at the state level, is undoubtedly innovation, so it is not exaggerated to say that it is in a moment of change where it is essential to be able to include new processes in the activities that are developed throughout organization, this in order to promote the mobilization and management of information in an appropriate manner that allows and improves decision making.

Industry 4.0 comprises nine pillars that are developed in different areas or divisions of the areas that comprise organizations; these are:

- Big data and data analysis. Focused on the management and management of large amounts of information, allowing the processing of historical data that manages the fluctuation in the data within a given period.

- Autonomous robots. Mainly used in production processes and sometimes in the logistics and storage of merchandise.

– Simulation. It allows the implementation of new processes since their incubation, optimizes their use before they are implemented, and therefore, before economic investments related to these items are made.

– Systems for vertical and horizontal integration. It allows to integrate different applications and software to be able to implement activities within the areas involved, SCM, ERP and CRM are some examples.

– Internet of things (IIoT). Through the use of different electronic devices, communicated with each other, it is sought that activities that may be repetitive within an organization be facilitated, or as is currently done, for personal use, such as Home Automation.

– Cyber security. It focuses mainly on the implementation of adequate mechanisms to protect the information generated in all organizations, in order to prevent attacks or misuse of it.

– Cloud computing One of the main problems we have is the indiscriminate use of paper and physical artifacts to store information; This pillar aims to optimize and eliminate the use of these resources, implementing virtual spaces for this purpose.

– Additive manufacturing. Commonly known as 3D Printing, it allows generating useful prototypes in different areas, from the production of tools to useful molds to generate organs and medical accessories, which would reduce time and costs in transplants, making it possible to improve the quality of life of patients involved.

– Augmented reality. There is currently a great boom in this sector; mainly focused on the educational area, where a large part of educational material and tools, is being developed using this instrument, through various applications that are not only explanatory, but also applicative.
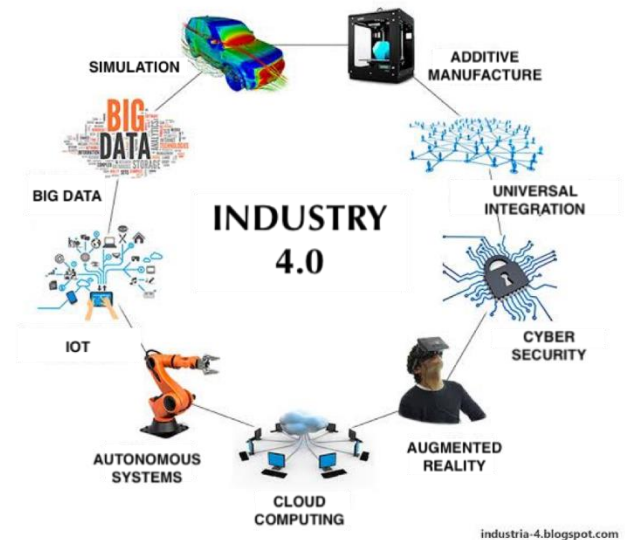

Figure 1 Pillars of Industry 4.0 (Sahifa, 2019)

Why is it important to include Industry 4.0 in higher education?

At present, there is a worldwide boom due to the use of any electronic device that allows us to have and manage information in real time, derived from it, procedures have been implemented that take us to use these elements to complement activities within and out of all organizations; the importance of implementing within the curricula, the pillars that Industry 4.0 manages, part of the fact that it is not good to stay with a technological lag, therefore, teachers must be trained first so that they can adapt curricula to the use of cutting-edge technologies and tools.

However, it must also be taken into account that the requirements and needs at the business level, are changing very regularly, so that institutional governments must focus a large part of the resources that are assigned to the improvement in technological equipment within the institutions, this may seem like a utopia, however, if you focus on the fact that this aspect can result in a win-win, you will have over time, the economic development that can bring you to society and then to country, resulting very attractive and very strong to take into account.

The student is responsible for forming new logical processes that adapt to the generation of responses to everyday problems in working life to which it will be included closely; hence lies the importance of including such activities as part of their academic training.

Figure 2 Digital technology (Elpaís, 2019)

It should be emphasized that, it should also be taken into consideration that knowledge represents 50% of the necessary mechanisms, the other 50% is made up of cognitive skills and abilities to create, solve, coordinate, make judgments, negotiate and be flexible in their resolution.

Figure 3 Skills by 2020 for students (Educational innovation, 2019)

Is the teacher really prepared for a paradigm shift towards Industry 4.0?

"Much of the technological learning is gradual and incremental. However, there is no inevitable progression towards an increasingly distant and always more unreachable border." (Rodríguez, 2017)

One of the most significant challenges to achieve the inclusion of students to Industry 4.0 is that education must be necessarily active and collaborative.

So that actions are included allowing students to practice problems based on real situations, simulating interaction in the various areas that may be related within the organization. This in order to create and develop ideas where the teacher is a facilitator in the process. The instruction must be bidirectional, therefore, the teacher must be able to allow a participation in the development and adaptation of the subjects of study, thereby achieving an autonomy that marks in the students the inclusion of interesting content for the students.

Figure 4 Teacher and Industry 4.0 (Nuevo día, 2017)

In addition, the teacher must have knowledge about the use of technological tools, because at present, most of the classes are expected to occur in an interactive way, a fact that results in the fact that teachers must encourage the use of current technologies to promote results that include these elements.

We must always look for innovation, since it goes hand in hand with the change of paradigms in the students' way of thinking, they can no longer be expected to enter the classroom to receive instructions on the activities they are going to do, it is time to encourage in them abstract thoughts that allow them to issue solutions to tasks that are even repetitive or merely theoretical, the main thing is to optimize times, costs, resources and encourage collaborative work.

For this, it is very important that the instruction, the teaching staff and students with the technology go hand in hand, in order to fulfill the evaluation correctly and adequately satisfy the skills that are required to fulfill professional functions within the organizations , who already require and use the different resources in terms of technology to benefit in the decision-making process effectively and efficiently.

In addition to this, it must also be understood that there is an increasingly competitive market, where there are more and more people prepared in the use of digital tools, transnational companies where large amounts of information must be managed in real time and have it available of all, activities to get products and services to more people in a large number of places; All of this implies that school preparation must be of the highest quality.

Previously, it was said that teachers should serve as guides and imparters of knowledge, in this reality, nowadays teachers "encourage" the acquisition of knowledge, show the whole range of wisdom for young people to develop jobs that activate their critical sense , participation, inclusion and flexibility of thought, not only to make knowledge, but also to implement issuing real solutions, applicable to the society of which they are part.

For the aforementioned it is important that the teacher is integrated to the use of technological tools, but in case it is not provided, strategies for adoption of the technological tools will be sought, through teaching courses, stimulation and benefit of the use of tools within the classroom.


Figure 5 (Engeman, 2109)

How do students impact the inclusion of knowledge focused on Industry 4.0?

Despite the reactions that may exist, as in any change, it is very important to make known and use new tools, which are considered of interest to young people in higher education, who see in their use a way to gain experience that may be applicable at the time of insertion in the professional environment.

The technological education that is sought, will promote cognitive development environments that focus on the implementation of new ways of carrying out the work, new implements of productive processes and improvement in the optimization of resources for its adaptation within the different areas of an organization. According to the study conducted at the IES, students who have knowledge about the pillars that Industry 4.0 manages demonstrate that they have managed Cloud Computing as a support tool in the development of projects and school activities, although they have their own knowledge in the other disciplines that are part of it.
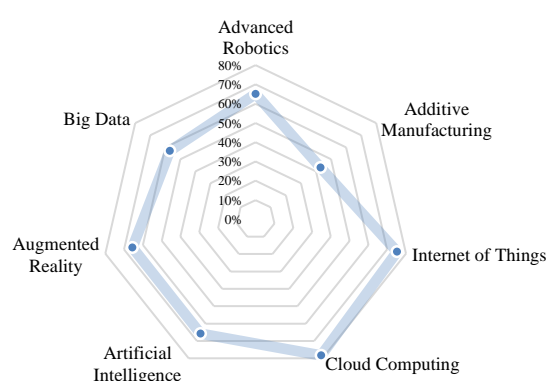
Graphic 1 Level of knowledge of technological tools

The following graph shows what information students perceive about the importance of handling any of the pillars of Industry 4.0 in relation to the elements necessary to perform required activities in the labor field.
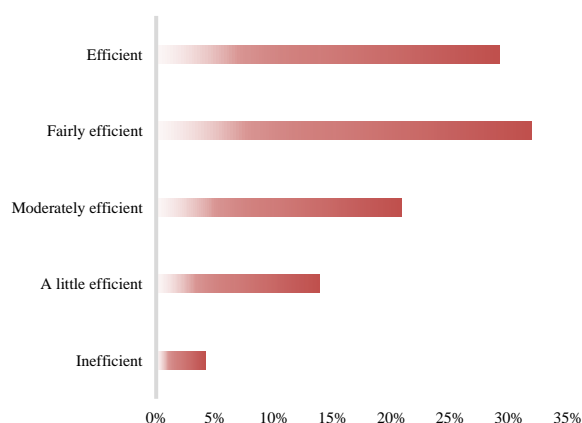
**Graphic 2** Efficiency perceived in the HEI

As can be seen, only 27% of the respondents consider that the management of the tools of Industry 4.0 is important to be able to carry out and implement work activities that cause a real impact and that the work carried out is truly significant.

Profit vs. Investment

According to the study carried out within the campus of higher education (IES), it is visualized that students are very interested in knowing and adapting to new technological tools, for this, teachers must be prepared to adapt the curricula with inclusion of projects based on case studies, where answers are given to real situations that help students to understand that reality at work causes different paths to be taken into account to generate a solution, which is important to include different areas of the company in the decision-making process, because all the areas intervene to a greater or lesser extent and that managers must have openness to allow impact responses to adapt according to the requirements and cutting-edge technology.

The results obtained also show that it is an important time to change the educational paradigm, not only can you continue to instruct on the basis that the teacher is always right and education should start from it, it is important to show that students have everything type of digital tools that make it a technological inhabitant. Therefore, it should include activities that allow an alternative thought development, which combines with technological actions and from there, allow more active participation within the different educational disciplines.

Perception of the inclusion of technological tools to the study program
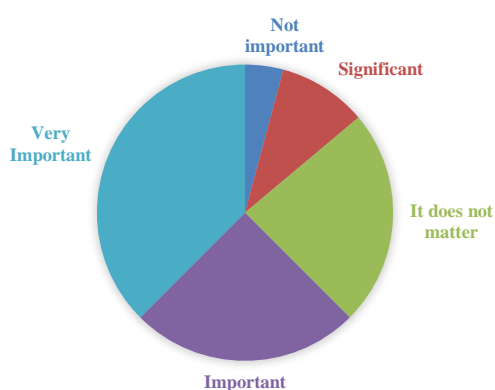
Graphic 3 Grado de aceptación de herramientas tecnológicas

Results

It has been found that, for students, it is very important to combine the implementation and use of the seven pillars of Industry 4.0, in order to adapt to the use of current technologies that guarantee adequate adaptation to the resources that are considered indispensable within of the companies; innovation forms a very important issue as well, since, it is not about discovering the black thread, but about adapting it and giving it new uses where required.

Conclusions

Everything indicates that the country is slowly moving towards development, and one of the factors that affect it is precisely the fact that digital technology is not introduced into companies, because the processes in organizations have not adapted to the requirements that They can make our country as a competitive nation.

Much of the lack of advancement is that, from the educational foundations, there is no recognition of the importance of optimizing resources and costs based on including cutting-edge technology for its development.

Therefore, it is recommended to adapt the HEI curricula, and train teachers so that their role as instructors is adequate to meet the needs of companies or small businesses that are in development, because it would be a key point to stimulate to the students and you are beginning to see the higher institutions and graduates with the expertise of handling any pillar that makes up the industry 4.0

It is also recommended to have a company-IES link, since that would have greater openness so that students and teachers can carry out research or practices that bring them closer to the labor field in which they will face once they have graduated from the institutions having greater panorama to give proposals. or solutions to companies. Hay que hacer incapié en adaptar los planes de estudio y en capacitar a los docentes para que su papel como instructores y guias sea adecuado para cubrir las necesidades de la vida actual.

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Using the Edpuzzle tool for teaching programming logic in higher education

Utilización de la herramienta Edpuzzle para la enseñanza de la lógica de programación en el nivel superior

TOLANO-GUTIÉRREZ, Helga Karina†*, AMAVIZCA-VALDEZ, Laura Olivia, PORTELA-PEÑÚÑURI, Luis Tadeo and GÁMEZ-WENDLANDT, Julio César

Universidad Tecnológica del Sur de Sonora

ID 1st Author: *Helga Karina, Tolano-Gutiérrez* / **ORC ID:** 0000-0002-3848-8115, **Researcher ID Thomson:** W-2091-2018, **CVU CONACYT ID**: 436643

ID 1st Coauthor: *Laura Olivia, Amavizca-Valdez* / **ORC ID:** 0000-0003-1614-110x, **Researcher ID Thomson:** W-2140-2018, **CVU CONACYT ID**: 877335

ID 2nd Coauthor: *Luis Tadeo, Portela-Peñuñuri* / **ORC ID**: 0000-0002-1597-7047, **Researcher ID Thomson:** AAG-2968-2019, **CVU CONACYT ID**: 761415

ID 3rd Coauthor: *Julio César, Gámez-Wendlandt* / **ORC ID:** 0000-0001-9909-688x, **Researcher ID Thomson:** W-6196-2018, **CVU CONACYT ID**: 898833

Abstract

This article consists of a quantitative investigation that shows the results of the use of Edpuzzle as a learning tool in a face-to-face class of a programming course offered at the Technological University of Southern Sonora (UTS). The study consisted in the development of an interactive video on the Edpuzzle platform to deliver and evaluate a topic that students sometimes consider difficult to learn. The tool allowed the evaluation of the students who used the learning material developed for the topic. An analysis was made of the resulting information that showed a higher performance, with a difference of 17.14 percentage points, in the group that used the tool. Also, students participating in the experimental group expressed, through a non-formal interview, that the application seemed different to how the classes are conducted at the University, but they considered it very attractive, dynamic and interesting to use in future classes to support other topics.

Teaching-learning, Programming, Edpuzzle

Resumen

Este artículo consiste en una investigación cuantitativa que muestra los resultados de la utilización de Edpuzzle como herramienta de apoyo para el desarrollo del aprendizaje en una clase de modalidad presencial, correspondiente a la asignatura metodología de la programación de la carrera de Desarrollo de Software Multiplataforma, en la Universidad Tecnológica del Sur de Sonora (UTS). El estudio consistió en el desarrollo de un video interactivo en la plataforma Edpuzzle para exponer y evaluar un tema que en ocasiones resulta complejo de entender, permitiendo evaluar la comprensión de los estudiantes que utilizaron este material. Se hizo un análisis de la información resultante que mostró un mayor desempeño con una diferencia de 17.14 puntos porcentuales en el grupo que utilizó la herramienta. Los estudiantes participantes en el grupo experimental manifestaron, a través de una entrevista no formal, que la aplicación les pareció diferente a como llevan sus clases en la Universidad, pero la consideraron muy atractiva, dinámica e interesante para llevar en futuras clase como apoyo a los temas que se desarrollan en las diferentes asignaturas.

Enseñanza-aprendizaje, Programación, Edpuzzle

* Correspondence to Author (email: ktolano@uts.edu.mx)
† Researcher contributing first author.

Introduction

Young students seek, require and demand new ways of acquiring knowledge inside and outside the classroom, with personalization and interactivity characteristics, based on current technologies, complementing or changing the traditional way we use to generate learning.

Technology-based learning tools can be a complement to support the face-to-face computer programming courses, some of these artifacts were not designed solely for an approach or environment, but can simply be tested and see that it works in different modalities, therefore they do not limit in that aspect the work of the teacher. An interesting example of these experiences is shown in a study by the University of Alicante in 2017, which raises the Edpuzzle tool as an educational platform in itself, which allows the method of inverted learning to be exploited. But not only such a method, but also seeks to be an effective complement in the transmission of knowledge, this through multimedia content within the class, which is a format of the most used and successful to generate knowledge today. Edpuzzle, allows you to choose any video, add voice memos and questions, as well as monitor student understanding.

Problem Statement

According to information from the National Center for Educational Statistics of the United States, it is around 2005 when an important decrease in enrollment and an increase in the dropout rate in computer programs began. This has caused a deficit of qualified IT professionals that meets the demand currently in the labor market (Roberts, 2016). And although recently there has been a slight increase in this type of enrollment, the number of students in these programs is far from being what they initially were and meeting current employment demands. Generating experts in the programming discipline requires developing computational thinking, fostering students' logical and mathematical skills. To implement the solution of a problem through the use of a computer it is necessary to establish a series of steps to solve a problem, this set of steps is called an algorithm, which should have as a final feature the possibility of easily transcribing it to a programming language (Zamora, sf).

Teaching-learning programming has been a recurring problem in recent years around the world. Over time, many solutions have been proposed without any of them being really effective. The lack of an in-depth study of the skills that they must acquire is added to the motivation problems of the students, often reducing the courses to a syntactic structure of a programming language (Villalobos, 2009).

The main causes of the difficulty in learning to program computers is that their teaching is based on the process of migrating from natural language to an artificial language such as programming, using mainly application software designed by large corporations that is manifested in concrete activities with these programs. Using a compiler from a specific company forces you to write certain codes in your own way or limits the use of others; In this way, you learn directly to program about language, but without guiding the student towards creativity, problem solving and logical abstract reasoning (Pérez, 2015). These forms of teaching programming often contribute to generating rejection, demotivation and difficulty in achieving learning. Unfortunately, students often experience fear and intimidation regarding introductory programming language courses (Sun, 2018).

Students seek, require and demand new ways of acquiring knowledge in this and other disciplines, inside and outside the classroom, with personalization and interactivity characteristics, based on current technologies, complementing or changing the traditional way we use to generate learning.

The Technological University of the South of Sonora has taught programming for more than 16 years, frequently presenting high rates of disapproval, attrition, demotivation and frustration in students, which is why it becomes a necessity to seek to innovate with other methods of teaching learning. These works can be started with the use and testing of some current teaching tools that could contribute to improving these indicators. Edpuzzle will be used to support the development of learning a topic in face-to-face class, of the programming methodology subject, of a group of the Multiplatform Software Development career, of the Technological University of South Sonora.

Trying to explore, apply and collect the results of the use of the learning tool, with the objective that the process is interactive and motivating, but at the same time trying to develop the computational logic on which the programming is based, allowing each student go at their own pace on the subject and promote learning autonomy.

Methodology

This study is of quantitative type and consisted of the use of the Edpuzzle tool to evaluate the learning of a group of students in the topic of flowcharts, of the programming methodology subject of the University's Multiplatform Software Development program Technology of Southern Sonora. A total of 19 students participated in this work, where 5 of them were in the pilot phase. Another 7 young people received a short interactive video to support some reagents of exposed content as support material for the classroom.

The rest, 7 students, were evaluated in a traditional written way through a questionnaire to measure the learning obtained. All of them randomly selected and enrolled in the same school group to take care of equal conditions (such as teacher, schedule, content and previous topics seen in class).

Descriptive sheet of the experimental group:

The experimental group to carry out the application of the tool consisted of 7 students of the Multiplatform Software Development career, first semester, 3 women and 4 men. All of the same group "A", therefore are on equal terms, as factors such as teacher performance and schedule among others do not affect the results of the experiment since they have the same teacher, schedules, previous topics, etc. Students were randomly chosen using the "random" tool (random.org) and their ages ranged from 17 to 19 years. All of them had to register on the Edpuzzle platform and be evaluated using the tool.

Descriptive sheet of the group without treatment:

The untreated control group consisted of 7 students of the Multiplatform Software Development career, first semester, 2 women and 5 men.

All of the same group "A", therefore are on equal terms, as factors such as teacher performance and schedule do not affect the experiment since they have the same teacher and materials. Students were randomly chosen using the "random" tool (random.org) and their ages ranged from 17 to 19 years. This group was only given a 50-minute session addressing the issue and subsequently provided with the printed assessment tool, without access to supporting material.

The tool with which the evaluation was developed was Edpuzzle, an interactive video of the topic Data Flow Diagram (DFD) was created, using an existing video of the topic, to which a questionnaire, voice notes and comments were added.

To access the tool you can access the Edpuzzle.com site, you must register and enter the password of the course that is datumle.

Programming Methodology is ready for your students

That was easy! Here is the Class Code you can forward or print for your students. It is they key to connect them to your class.

Instructions for your students:
1. Go to edpuzzle.com and create a student account (no email address needed!)

datumle

2. Enter the class code when needed and complete the sign up
3. Explore your new class and assignments!

Figure 1 Entry to course on platform
Source: Edpuzzle.com

Evaluation tool (reagents):

1.   A flow chart is:

They are a set of symbols that allow communication.
It is the graphic representation of an algorithm.
It is a set of steps to solve a problem.
It is the symbolic representation of a problem.

Feedback: A data flow diagram is the graphical representation of an algorithm through symbols that relate to each other and indicate that the instructions must be executed to obtain a result.

TOLANO-GUTIÉRREZ, Helga Karina, AMAVIZCA-VALDEZ, Laura Olivia, PORTELA-PEÑÚÑURI, Luis Tadeo and GÁMEZ-WENDLANDT, Julio César. Using the Edpuzzle tool for teaching programming logic in higher education. ECORFAN Journal-Republic of Paraguay 2019

2. The characteristics of the flowcharts are: They have a beginning and an end, they are read from top to bottom and from left to right.

They can have several beginnings and are read from left to right. It has a beginning and they are read from right to left. They have a beginning and an end, they are read from the bottom up and from right to left.

Feedback: A flowchart is characterized by:
– Have only one starting and ending point per diagram.
– They are interpreted from top to bottom (top-botton) and from left to right (left-right).

3. This DFD symbol represents the actions to be executed in a data flow diagram.

Decision.
Data flow lines.
Data entry
Process
Departure
Feedback: The process symbol represents the actions to be executed in a data flow diagram.

4. It is the first step to develop a DFD.

Draw the start symbol and draw a line with vertical flow to join it with the following symbol.
Identify data inputs and outputs.
Assign a title to DFD.
Feedback:

The first thing we have to do when developing a DFD is to identify the data inputs and outputs that we need to solve the problem through this tool.

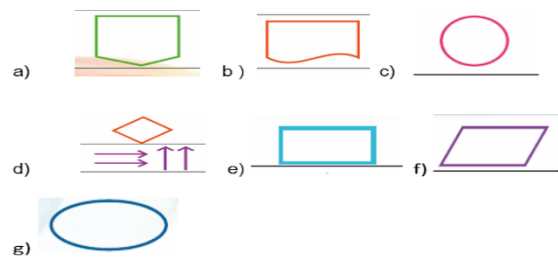5. Indicates that it represents each symbol that composes a flowchart.

Figure 2 Flowchart Symbols
Source: Own Elaboration

Terminal ( )
Entrance exit ( )
Process ( )
Decision and Flow Lines ( )
In-page connector ( )
Off-page connector ( )
Print ( )

Results

The results obtained from the application of this tool were the following:

First, we proceeded to empty the results obtained in the first group, the experimental group, who used Edpuzzle as a support tool for the topic seen in Data Flow Diagrams (DFD). The following information was obtained:

Experimental group		
	First name	Pts. Obtained (of 5 in total)
1	Hernández Grijalva Luis Manuel	2
2	López García Luis Aarón	4
3	Félix Ayala Manuel De Jesús	3
4	Rivas Vega Rosa Elizabeth	5
5	Loera Duarte Noelia Yenedit	5
6	Palafox Cuen Itzel Samantha	4
7	Esparza Peinado Hansel Jesús	5
	Average	80
	Mean	4

Table 1 Results obtained in the experimental group
Source: Own Elaboration

Subsequently, the data obtained from the second group were concentrated, which only received a traditional session (presentation by the teacher) and the subject evaluation was applied.

Control Group		
	First name	Points. obtained
1	Encinas Simuez Olga Guadalupe	2
2	Enríquez Valencia Ohman Santana	3
3	Estrella Parra Ramón Alberto	3
4	Valdez Gaytán Ariel Armando	3
5	Flores Lumbrera Isabel Alejandra	4
6	Hernández Coronado Jorge Enrique	3
7	Yépiz Sanez Dinorah Guadalupe	4
	Average	62.86
	Mean	3

Table 2 Results of a traditional printed evaluation tool (questionnaire)
Source: Own Elaboration

Finally, an analysis of the information was made, which shows that the results of the evaluation, which are of higher performance in the experimental group that used the interactive video. Specifically there is a difference of 17.14 percentage points, which indicates that the group with treatment had a better learning. Likewise, the average was 4 points in the experimental group and in the group without treatment it was 3 points. The students were interviewed, who said that the tool seemed different to how they take their classes at the University, but they considered it very attractive, dynamic and interesting to take in class to support the subject.

An intervention plan was developed with the objective of carrying out some actions to improve student performance, in current and future programming methodology topics. This according to positive results that were obtained with the interactive multimedia material. These activities consisted of peer counseling (personalization of the advisory activity), complement the face-to-face course with a MOOC (Massive online open course) to support the teaching of programming logic which uses tools similar to Edpuzzle and develop continuous evaluations using multimedia material that allows Edpuzzle.

Conclusions

A teacher today must be able to adapt to the current needs of students, the use of applications and technologies in education, this due to the positive results obtained from the use of some or many of them in learning.

There is a great variety, however, some have already been subject to research and successful experiences, which allow them to be tested in groups with greater confidence, especially those that use audiovisual content, which are widely accepted, motivating and have had good results among the student population.

The Edpuzzle tool for its multimedia and interactivity characteristics can be considered a good option to teach the basics of programming logic and allow students not to see their contents as boring and demotivating, as well as with important features such as each student can advance to your own pace Further research will be carried out by applying this tool to others of the program and others for complete programming courses. Likewise, in the long term it is intended to generate a successful methodology that allows solving current problems in programming teaching.

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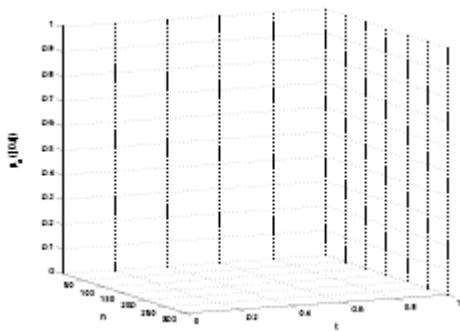
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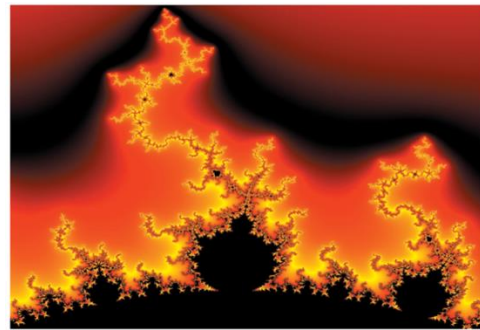Should not be images-everything must be editable.

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