METHODOLOGY FOR THE REUSE OF TECHNOLOGICAL WASTE IN THE SUBJECT OF COMPUTER ARCHITECTURE

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ABSTRACT

Information and Communication Technologies (ICT) are incorporated into everyday processes in people's practical lives. Man's demands for technology are increasing, significantly reducing the time of use of the media, causing the phenomenon known as technological obsolescence. The problems described above directly impact the environment through garbage dumps, the escape of particles into the seas, among other effects. In Cuba, numerous efforts are being made to reduce the impact on the ecology for which a recycling program has been drawn up through the Raw Materials Company. However, there are components that, due to their nature of construction or composition, are not possible to recycle with the tools that the country currently has. This research describes a solution to the problem posed by creating a methodological proposal aimed at technological reuse. The field of action is the Computer Architecture subject taught in the Computer Science Engineering career, a set of activities is proposed for distribution in the subject contents.

KEYWORDS: recycling; technological reuse; electronic trash.

METODOLOGÍA PARA LA REUTILIZACIÓN DE LA BASURA TECNOLÓGICA EN LA ASIGNATURA DE ARQUITECTURA DE COMPUTADORAS

RESUMEN

El desarrollo de las Tecnologías de la Información y las Comunicaciones (TIC) han representado una nueva forma de gestionar los procesos cotidianos en la vida práctica de las personas, de este modo cada vez son más las exigencias del hombre para las tecnologías, disminuyendo

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significativamente el tiempo de utilización de los medios causando el fenómeno denominado como la obsolescencia tecnológica, elemento que impacta directamente en el medio ambiente a través de los basureros, el escape de partículas hacia los mares, entre otros efectos. En Cuba, se realizan numerosos esfuerzos para disminuir el impacto en la ecología para lo cual se ha trazado un programa de reciclaje mediante la Empresa de Materias Primas. Sin embargo, existen componentes que por su naturaleza de construcción o composición, no son posibles reciclar con las herramientas que posee en la actualidad el país y son contratadas empresas extranjeras para realizar dicha función, aspecto que se encuentra limitado por el bloqueo económico. La presente investigación describe una solución a la problemática planteada mediante la confección de una propuesta metodológica encaminada a la reutilización tecnológica. Se toma como campo de acción la asignatura Arquitectura de Computadoras impartida en la carrera de Ingeniería en Ciencias Informáticas, se propone un conjunto de actividades para su distribución en los contenidos de la asignatura que permitan fomentar hábitos y habilidades para la reutilización tecnológica.

PALABRAS CLAVE: reciclaje; reutilización tecnológica; basura electrónica.

INTRODUCTION

An element that has been given vital importance in recent years has been the introduction of Information and Communication Technologies (ICT), which has marked new ways of materializing the world. Cyberspace is gaining ground in daily life and many tasks that to date required large infrastructures, human and material resources for their execution are now possible under the influence of the new technological systems introduced into society. While it is true that novel techniques can represent the basis of a modern society where it is possible to achieve in a correct, precise and satisfactory way practical objectives, people impose new challenges on existing technologies to the point where it is not possible to meet human needs In this way, technological obsolescence is born. Obsolesce is the fall into disuse of machines, equipment and technologies motivated not by their malfunction, but by an insufficient performance of their functions compared to current demands (Hidalgo, 2010).

Obsolesce causes many computers to go to waste in relatively short time creating what is called technological waste. A report by the United Nations Environment Program reports that currently between 40 and 50 million tons of electronic waste are generated per year (UNESCO, 2010), It is estimated that the volume of electronic scrap is growing between 16% and 28% every five years (Martínez, 2008). El creciente volumen de chatarra convierte a este desperdicio en el de mayor crecimiento en los últimos años (Duery, 2007). Table 1 shows a study on the composition of technological waste.

Table 1. Composition of technological waste.

Waste type	Composition
1. Ferrous metal	39.1 %
2. Nonferrous metals (Al, Cu, Au, Ag.)	21.0 %
3. Plastics	14.2 %

4. Monitors Glass /TV	13.4 %
5. Mixed Materials with Plastics	5.8 %
6. Cables	2.2 %
7. Printed Circuit Boards	1.9 %
8. Others	1.6 %
9. Hazardous Materials Fraction	0.8 %

Based on the volume and types of waste generated as technological waste and the insufficient measures taken by the different countries, aggravated by its exponential growth. The environment suffers the impact of technology discarded by man, constituting a social problem.

PROBLEM STATEMENT

Examples of the environmental impact of technological waste. For various reasons ranging from accident to intentionality, a large accumulation of waste is dumped into the sea and, unfortunately, it is the ocean that is responsible for dramatically showing the abuse in the manufacture of plastic materials (which escaped recycling) with which the planet has been punished for the last 70 years (Bertheau, 2011).

It's hard to get an idea of its volume, but in the Pacific Ocean, somewhere between San Francisco and Hawaii, there is a huge island of garbage larger than France, Spain and Portugal. Experts refer to it as "the great garbage patch of the Pacific", although some, more gimmicky, prefer to call it "the seventh continent". Figure 1 shows an image taken by researchers in an area of the garbage dump.

Figure 1: Image taken at the garbage patch in the Pacific Ocean.

Available in: http://www.kienyke.com/historias/un-continente-de-basura-seis-veces-mas-grande-que-francia/

According to data provided by the National Center for Space Studies (CNEE), this group of floating human waste has objects of all kinds escaped from the sewers and millions of waste and small plastic particles, it measures 22,200 kilometers in circumference, which has an area of 3.4 million square kilometers (Cubadebate, 2012b).

Heavy materials and their effect on health and the environment. In electronic equipment it is possible to find heavy metals such as Lead, Cadmium, Selenium and Mercury. Although its volume represents 0.8% of the electronic waste generated as referred to in table 1, it directly impacts human health, generating adverse effects. The effects caused by heavy metals are described below. Lead: Lead oxide is used in Cathode Ray Tube (CRT) monitors on computers and televisions. Exposure to lead causes intellectual decline in children and damages the nervous, bone, blood, and reproductive systems in adults. Lead in the environment becomes dangerous when it dissolves in water in the presence of air. This pollutant can reach people not only through water but also through the ingestion of vegetables and fruits that have absorbed lead from the soil (López, 2008).

Mercury: this element is present in electrical current switches, old equipment, and electromechanical relays. It is a heavy metal that is liquid at room temperature, whose vapors, when inhaled, pass easily from the respiratory system to the nervous system; it has the characteristic that it can be distributed globally, until it becomes water-soluble forms that allow its return to the earth with water. of rain (Itigil, 2008).

When the poisoning is severe or due to prolonged exposure it becomes chronic and damage to brain functions, negative effects on reproduction, even DNA damage are observed. Like lead, this metal not only enters the body through direct contact, but also when food of plant or animal origin or contaminated water is ingested (Taboada, 2009).

Cadmium and Selenium: These metals are present in circuit boards. Selenium as a rectifier of the power supply and cadmium as part of semiconductors. Cadmium poisoning initially manifests itself with symptoms of diarrhea, stomach pain, and vomiting. If the exposure is prolonged, bone weakness and nervous system disorders appear, generally accompanied by different psychological and behavioral disorders. Chromium, Cobalt and Manganese: these metals are components of the steel used in metallic parts of the equipment. Chromium is present in alloys to give them anticorrosive properties and also in certain decorative elements of equipment and Cobalt allows giving strength to structures. Both Cobalt and Manganese are present for magnetivity. Chromium is one of the heavy metals with the highest toxicity and can enter the body through the respiratory tract, be ingested by eating or drinking contaminated food or by direct contact with the skin. It causes rashes, stomach upset, ulcers, respiratory problems, weakened immune system, kidney and liver damage, lung cancer and in severe cases, death (M. González, 2011).

DEVELOPMENT

In order to protect the environment and preserve it from pollution generated by waste from electrical and electronic equipment (EEE), there are several bills in Latin America that try to reduce final disposal, promote reuse, recycling and other ways of recovering the aforementioned waste (Paredes, 2012).

Following the example of many current bills, future regulations should address the following points:

• Incorporation of life cycle analysis in PREPA design and production processes.

• Promotion of the reduction of waste generated by the aforementioned devices.

• Definition of the concept of EEE as opposed to the concept of waste electrical and electronic equipment (WEEE).

• Determination of exceptions and inclusions in the legislation.

At the regional level, the Southern Common Market Council (MERCOSUR) presented the Agreement on MERCOSUR Policy on Environmental Management of Special Waste of Universal Generation and Post-Consumer Responsibility (Piera, 2010).

In it, the ministers of the member states acknowledge that there is a considerable increase in the transfer of waste, mainly from developed countries to developing countries, for which it is necessary to adopt common policies on waste and post-consumer responsibility of products. , considering the possible environmental, economic and social impacts in the region. This agreement includes the same waste as the Chilean project and incorporates the concept of extended producer responsibility (Martínez, 2005).

Cuba bets on recycling. The recycling industry in Cuba was created to recover values by the Heroic Guerrilla, Commander Ernesto Che Guevara on November 7, 1961. The noble and visionary idea of Che takes shape when the Revolution has not yet reached its third anniversary, which increases the merit of employing talent and dedication in giving life and sustenance to this industry, in order to substitute imports of essential raw materials for the country's economy.

The Union of Companies for the Recovery of Raw Materials is the state entity in charge of the recovery, processing and commercialization of recyclable waste that is generated both in the residential sector and in the state sector (in the productive, commercial and service provision spheres). To fulfill this task, it has more than 7 thousand workers organized in 25 companies, with representation in all provinces and municipalities. Recently, recyclable waste collectors on their own have joined the activity, which today amount to more than 5 thousand 700.

The routes used for the recovery of recyclable waste in the country are:

• Contractual purchasing relationships with state entities, by virtue of Law 1288 of 1975, which obliges all those legal entities that generate waste in their production or service rendering processes, which are not going to be reused by themselves, deliver them to recycling.

• The houses that buy raw materials for the population, which make up a network of 312 establishments scattered throughout all the municipalities of the country and which annually receive more than one million vendors. The only requirement that is required to carry out the sale of waste is to present the identity card. There is a group of products, the reception of which is prohibited by this system, such as: dowels and new laminates of bronze, copper and aluminum; sprinkler irrigation pipes and their components; replacement parts; sewer grates; copper telephone and power cables with and without sheath; items from cemeteries (crosses, tombstones, slabs, statues); utensils, parts and pieces of weapons and military equipment in disuse; industrial aluminum radiators and condensers; retorts and slags; shavings and filings; zinc dross; scrap from the dismantling of airplanes, ships and rail equipment; bearings and pedestals; Road signs; hydraulic manhole covers; hydrant caps; church bells; parts of monuments; motors and gearboxes for motor vehicles; pieces from sugar mills; locomotive and railroad car brake shoes; weight patterns; forklift counterweights; manganese steel mat tiles; park benches; profiles and spreaders of electrical towers; and elements, parts and pieces that make up the railroad track. This prohibition is intended to prevent vandalism against products that fulfill an economic or social function.

• The Pioneer Recovery of the Future Movement, which involves new generations in the economic and environmental importance of this activity.

• The mini-festivals for the collection of raw materials through the CDRs on designated dates and previously organized in conjunction with this organization. Around 430 thousand tons of waste are currently recycled each year, of which 35% comes from the state sector, 64% from shopping houses to the population and 1% is contributed by walkers and pioneers. Among the products that are recycled are more than 300 thousand tons per year of ferrous scrap, destined for steel mills, for the production of liquid steel and its derivatives. The price of this raw material in the international market is 400 USD / ton, which means that this supply replaces imports amounting to 120 million USD per year.

They also commercialize non-ferrous scrap such as copper, bronze, stainless steel, lead, and aluminum, both to national industries and for export, a concept for which more than 50 million dollars are entered annually.

Non-metallic waste such as paper and cardboard is supplied to paper mills and other industries for the production of school notebooks, toilet paper, egg trays, and roof tiles for houses, among others. The cost of a ton of this product is in the order of 200 USD in the international market. The recycling of 37 thousand tons of this product represents more than 7 million dollars in savings (Cubadebate, 2012a).

In a similar way it happens with the textile containers, essential for the food program, the glass containers that annually amount to more than 75 million units in their different assortments.

The economic blockade and its impact on Cuban technological garbage. There is a group of waste that due to its complexity, Cuba does not have the necessary technology for its treatment, making it necessary to hire external companies. Once again, the hegemonic power of the superpower is revealed where even electronic scrap is blocked.

A California-based company that recycles metals and electronic components agreed to pay a $ 44,000 fine for doing business with Cuba, in violation of the iron blockade imposed by Washington against the Caribbean nation. The Tung Tai Group company, with offices in Burlingam and warehouses in San José, both cities in that western US state, specializes in buying scrap for export to China and other Asian markets. According to a statement from the Office of Foreign Assets Control (OFAC), which is in charge of pursuing all Cuban commercial and financial transactions, in August 2010 Tung Tai acquired scrap from the island.

OFAC reported that another company, the Great Western Malting Co. of Vancouver, Washington State, had agreed to pay a $ 1.35 million fine for unauthorized commercial transactions with Cuba.

Economic policy and its environmental impact.

Due to the necessity that science and the environment coexist in harmony, the Republic of Cuba in its Guidelines to regulate the Economic and Social Policy of the Party and the Revolution, dictates the behavior to be followed in the area of science, technology, innovation and environment for which it dedicates six guidelines (PCC, 2011).

Description of the guidelines that define the Cuban environmental policy:

130: The adaptation of the required measures of functional and structural reorganization and update the pertinent legal instruments to achieve the integrated and effective management of the Science, Technology, Innovation and Environment System.

133: Sustain and develop comprehensive research to protect, conserve and rehabilitate the environment and adapt environmental policy to the new projections of the economic and social environment. Prioritize studies aimed at confronting climate change and, in general, at the sustainability of the country's development. Emphasize the conservation and rational use of natural resources such as soils, water, beaches, the atmosphere, forests and biodiversity, as well as the promotion of environmental education

134: Economic entities in all forms of management will have the regulatory framework that encourages the systematic and accelerated introduction of the results of science, innovation and technology in production and service processes, taking into account the rules of responsibility established social and environmental

136: In the agro-industrial activity, the application of an integrated management of science, technology, innovation and the environment will be promoted throughout the productive chain, aimed at increasing food production and animal health, including the improvement of services to producers, with reduced costs, greater use of components and inputs of national production and the use of scientific-technological capacities available in the country.

138: Pay greater attention to the continuous training and qualification of technical personnel and qualified cadres that respond to and anticipate the scientific and technological development in the main areas of production and services, as well as the prevention and mitigation of social and environmental impacts.

139: Define and promote new ways to stimulate the creativity of grassroots labor groups and strengthen their participation in solving the technological problems of production and services and promoting environmentally sustainable forms of production.

Delimitation of the investigation

In September 2002, the University of Computer Science opened its doors with the mission of training Computer Science Engineers with a technical profile directed to the area of technologies.

The training model is inspired by a technology park, where it is possible to promote the university-company relationship by encouraging innovation and facilitating the transfer of technology from the university to the economic sectors (Castro, 2004).

The technological infrastructure created to support the Teaching, Productive and Research processes groups around 6000 workstations distributed in laboratories, departments, offices and residential areas. For an organization that supports its processes on the new techniques and technologies existing in the world and with a wide and diverse market for the development of computer products, technological updating represents a programmed task (Mar, Argota, & Santana, 2016).

Thus the obsolescence of technology represents a backward timer. For the concept of technological renewal until 2008, the organization had recycled 1/6 of the available technology. Nevertheless:

• Not in all cases the technology was out of order due to a breakdown in the components that are part of the computer architecture.

• The treatment carried out for all cases was the cutting and classification of the elements for recycling.

The recycling process of the technological components is carried out by the Raw Materials Recovery Company, this being the final destination of the resources.

Justification

Recycling or reuse. The term recycling has been treated in previous appendices as the use of waste for the manufacture of the same product or the manufacture of new products (Gonzáles, 2007).

However, it is possible to carry out other operations that are not linked to the recycling processes, such actions are called reuse. If the definition of technology by Núñez Jover is taken as the basis of scientific-based industrial techniques, promoted by the need for industrial organization (Núñez, 2003).

Technological reuse would represent a form of technological evolution where it is possible to change the mission of a device that has morally expired to use in inferior functions without the use of new investments. Based on the definition proposed by the author of changing the mission to devices that have morally expired as an element capable of impacting on ethics, science and technology (Arencibia, 2008), It would be contributing to business economic management with guideline seven that proposes ensuring that the country's business system is made up of efficient companies. Efficiency in this sense would be based on the elimination of exports, the acquisition of technology to increase productivity in areas of the business sector, and a direct contribution to the environment would be obtained.

Limitations

The proposal presented by the author is adjusted for contexts, where it is possible to change the purpose of obsolete technology and provided that it has not lost its technical operating conditions. In the event that the technological means is damaged or out of service, the recommended procedure would be the recovery by the Raw Materials Company. The degree of generalization that the proposal can have would be innumerable (J. González & Mar, 2015), since it is possible to start from a simple automated control system, to the use of computer systems with low benefits for the business sector.

Objectives

For the development of this research, it is proposed as an objective: to develop a methodological proposal to contribute habits, skills and values to the technological reuse from the Computer Architecture subject, reducing the negative impact on the environment of obsolete information technologies. To understand the proposal, the following variables are raised: Dependent variable: environmental impact of the technology. Independent variable: methodological proposal to contribute habits, skills and values to technological reuse.

Kind of investigation

For the proposed research, where the environmental impact of the technology that you want to directly influence with a methodological proposal to contribute habits, skills and values to technological reuse is considered as a dependent variable. Represents the formalization of an experimental design where you want to demonstrate the correlation of the process variables. The term "experiment" refers to "taking an action" and then observing the consequences. The essence of this conception is that it requires the intentional manipulation of an action to analyze its possible effects.

The particular meaning, more harmonious with a scientific sense of the term, refers to "a research study in which one or more independent variables (supposed causes) are deliberately manipulated to analyze the consequences that manipulation has on one or more dependent variables (supposed effects), within a situation of control for the researcher " (Sampieri, 2006).

Three types of experimental designs are defined; Pure Experiments, Quasi-experiment and Pre-experiment A pure experiment manipulates independent variables to see their effects on dependent variables in a control situation. It is necessary that the measurements made to the study phenomenon be reliable to guarantee its validity.

The Quasi-experiment is used when the researcher intends to analyze effects in the medium and long term or effects of administering the experimental treatment several times, and does not have the possibility of randomizing the subjects to the experimental groups. The pre-experiments are called like that; because their degree of control is minimal. It consists of administering a stimulus or treatment to a group and then applying a measurement in one or more variables to observe what the group's level is in these variables. Based on the existing experiments, an experimental design is proposed to measure the contribution index to technological reuse from the Computer Architecture subject, specifically a pre-experiment is proposed.

Computer Architecture is the subject within Computer Science that is responsible for the study and evolution of technologies for computer systems, it has two fundamental topics that are hardware elements and the coding of routines in assembly language. Taking the dosed contents as references, it is possible to make proposals for activities that as a whole make up a methodological proposal where objectives and contents are intentionally reinforced, or what is the same as the actions aimed at the formation of values.

Techniques applied in the collection of information

To diagnose the current state of the study phenomenon, empirical scientific research methods were used, including surveys, interviews and observation. The survey was applied to the group of professors who teach the Computer Architecture subject. The 28 professors distributed in the seven faculties were taken as a population and it was applied to a sample of 9 professors for a 32.1% representation.

The interview was applied to the chief technical advisor of the Computer Architecture course. The observation was applied by a group of professors who teach the Computer Architecture subject. The 28 professors distributed in the seven faculties were taken as a population and it was applied to a sample of 5 professors for a 21% representativeness. With the use of the declared methods and the daily practice of the author, it was possible to show that in the cases analyzed, there is no intention from the Computer Architecture course for technological reuse.

Results and discussions structure of the methodological proposal

Step 1: identify the topics where it is possible to apply a proposal of activities that contributes to technological reuse.

Step 2: prepare the exercise proposal. In this step, the exercise to be carried out by the students is formulated, it is guaranteed in the action formulation process.

Step 3: content of the action. The object of study is contextualized where the action to be executed is framed.

Step 4: understanding the situation. The solution paths are analyzed, the different alternatives are characterized, the main objective being to determine the most optimal solution for the case to be solved.

Step 5: clarifying the pathways. The algorithm to be used to solve the problem is determined according to the conclusion derived from step 4.

Step 6: control and correction. The delivery times as well as the evaluative form of the action are agreed. Table 2 presents the orientation of the exercises as proposals to contribute to technological reuse.

Table 2: Proposal of exercises that contribute to technological reuse.

Topic of Table 3 to which the activity is proposed	Subject	Proposal for action	Possible result of the action
Topic 1	Modern computing systems architectures	1. Promote exercises that contribute to the characterization of technology against	Formation of values for technological reuse according to purpose.

		utility or purpose.	
Topic 2	Hardware programming	1. Promote exercises that contribute to the coding of routines in assembler for the automation of everyday life processes.	Training of practical skills for the reuse of low-performance technology in the automation of practical problems of daily life.

Application of the methodological proposal

Vygotsky's theory of activity (Vigotsky, 1924), explains the passage from external activity to internal activity in the human mind, Galperin applied it in a novel way in the teaching-learning process, when developing the methodology of the Theory of Training by Stages of Mental Actions (TFEAM) (Galperín, 1976).

This methodology suggests that to achieve the assimilation of knowledge, students must go through certain moments of the activity, made up of orientation, execution and control. Orientation refers to the teacher's tasks in which they are distinguished: motivation and the formation of the guiding basis for action. Execution essentially refers to the tasks performed by the students and in it the following are distinguished: the material or materialized stage, the linguistic training in which the external verbal stage and the external language "for oneself" are distinguished. Finally, there is the stage of the formation of the action in the internal language, which completes the formation of the action as a purely mental act.

Stages of the process of assimilation of knowledge.

1. Motivation stage.

2. Formation of the guiding base of the action.

3. Stage of material external actions.

4. Stage of actions in the form of language.

5. Stage of mental action.

1. Motivational stage

It is a stage of great importance, although sometimes it is not granted, through it many achievements can be obtained such as skills, interests, fosters occupational interest and a certain disposition for the content to be known. The student does not enter into any type of action, here the student is prepared to assimilate the knowledge. At this stage the tasks must create a favorable disposition towards the object. The methods must be problematic, linked to professional tasks. The means to be used can be videos, experimental demonstrations, textbooks, etc., and the teaching methods can be conferences or classes, meetings, where the teaching task constitutes a study guide (Corona & Fonseca, 2009).

2. Stage of the guiding base of the action (BOA)

It is the knowledge of the action and the conditions in which it must be carried out, it is where the student is given the necessary system of knowledge about the object of study (guides), the necessary conditions to take into account, the models of the actions to be taken. execute and the order in which these actions should be executed. At this stage there is no execution of the action by the student, only the knowledge of the action, which is why it is the moment prior to its execution. The student is shown the material that he has to assimilate, he delves into that action that solves the problem. The methods to be used are explanatory, problematic and joint elaboration. The media can be diverse, blackboard, slides, retro and it is given in the conference (Eiriz, 2012).

3. Stage materialized.

From the third stage, the execution of the action begins on the material or materialized plane, where the student performs the action and the teacher has the possibility of controlling its execution, as well as influencing its training and the correction or adjustment of the learning that is achieved. Students have to solve problems relying on external schemes, on the basis of a study guide. All of this requires helping students to appropriate cognitive, metacognitive and motivational strategies and procedures that allow knowledge to be produced (rather than consumed), solve problems, learn to learn permanently throughout life, and in different situations and contexts (Abreu, 2011).

4. Verbal stage

From this moment, in which the student has already mastered the action scheme and has in turn acquired the necessary knowledge, the conditions exist to go on to the stage of formation in the language plane, where the elements of the action must be represented verbally (oral or written). There is a codification in the form of a concept of material action. The methods are group, by discussion partner for creative problem solving. The establishment of this theory constitutes contributions in the establishment of the characteristics of the action, which must be taken into account in its formation, since they are indicators of its quality, being the most important in the present work (Campelo, 2003).

5. Mental stage.

This will be developed in the face-to-face meetings. In this stage, the language is internal, processed with its respective discursive strategy, the student must have internalized the contents, being able to transmit them by generalizing to new phenomena, thus moving towards absolute independence (Aníbal, 2008), (Guillermo & Ramírez, 2009).

The orientation of procedures to the students of this level, for the study and their independent activity, is fundamental to achieve "successes in learning", and, consequently, a high intellectual development, which allows them to apprehend knowledge, develop skills and that are formed in these values.

Table 3: displays an exercise proposal where actions are proposed to promote habits, values and the creation of skills for technological reuse, passing through the orientation phases.

Table 3: Proposal of exercises

Exercise	Topic	Understanding of the situation	Clarification of the routes	Control and correction
1. Taking the evolution of microprocessors as a reference, identify where it is possible to reuse each generation of microprocessors in practical life	1. Architectures of modern computer systems	1. Characterize each generation of microprocessors 2. Identify benefits of microprocessors against purpose. 3. Identify rational use of microprocessors	1. Determine the evolutionary leaps. 2. Propose rational use of microprocessors.	1. Establish the delivery schedule. 2. Establish the form of evaluation.
2. Create an assembly language program that makes use of the microprocessor interrupts to implement an alarm system for commercial facilities.	1. Hardware programming	1. Characterize a commercial alarm system 2. propose a functional structure of the proposed system. 3. Identify the interrupts to code.	1. Determine the possible algorithms to use. 2. Select the most suitable algorithm for the sequence. 3. Implement the solution.	1. Establish the delivery schedule. 2. Establish the form of evaluation.
3. Create an assembly language program that, using the interrupts of the microprocessor, allows you to activate or deactivate a micro controller for the movement of a robot.	1. Hardware programming	1. Characterize the microswitch systems 2. propose a functional structure of the proposed system. 3. Identify the interrupts to code.	1. Determine the possible algorithms to use. 2. Select the most suitable algorithm for the sequence. 3. Implement the solution.	1. Establish the delivery schedule. 2. Establish the form of evaluation.

4. Develop a program in assembly language that, using the interruptions of the microprocessor, implements a virtual laboratory for the teaching of applied movements in basic secondary physics.	1. Hardware programming	1. Characterize the types of movement to implement 2. propose a functional structure of the proposed system. 3. Identify the outputs to implement.	1. Determine the possible algorithms to use. 2. Select the most suitable algorithm for the sequence. 3. Implement the solution.	1. Establish the delivery schedule. 2. Establish the form of evaluation.

CONCLUSIONES

With the use of empirical methods such as survey, interviews and observation, it was possible to show that in the Computer Architecture course there are no intentional actions towards technological reuse. With the development of a methodological proposal from the Computer Architecture subject, it is possible to promote habits, skills and values in terms of technological reuse, helping to reduce the environmental impact of technological waste. With the introduction of the proposal in the business economic management model, it contributes to saving material resources, substituting imports for the concept of technological reuse.

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