PROPOSAL FOR THE ALGORITHM DESIGN'S DIDACTIC. Integrated V use.

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1. Abstract

The main purpose of this article is to propose a methodology for the algorithm design's teaching. This will be done using the "V" heuristic tool ,developed by Gowin and Novak, in order to improve the academic output in the education of computing engineers. This tool has already been used by some researchers in the teaching of various topics in Biology, Mathematics and Physics, as a part of the constructivist approach. Until now, it has not been applied in the field of computing.
Key words: Heuristic tool, Gowin's V, algorithm design.

2. Resumen

El objetivo del presente artículo es hacer una propuesta metodológica para la enseñanza de los algoritmos computacionales a través de la técnica heurística UVE, desarrollada por Gowin y Novak. La idea aquí considerada, cuyo fundamento epistemológico puede encontrarse en la corriente constructivista, tiene como antecedente su empleo en algunos temas de la biología, la física y las matemáticas. Su aplicación dentro de la computación no ha sido todavía llevada a cabo. La intención es mejorar el rendimiento académico de los alumnos de la materia de diseño de algoritmos, tomando en cuenta los resultados en dichas ciencias.
Palabras claves: Técnica heurística, V de Gowin, diseño de algoritmos.

3. Introduction.

I expose the application of the Gowin's V in the algorithm design's teaching, to improve the Computing Engineer carrier's at ESIME-CU as a part of the Universities' modernization. This will be made, attending to the need of solving their academic low output problems, which is the main cause of a high school desertion.
It is important to comment that in the algorithms' field, one of the hardest points is the fact that there is no "recipes" made to construct them. The same happens, for example, in resolving problems to Physics solution . The successful heuristic V application, by Moreira in Brazil, to the Physics teaching case, supposes, because of the mentioned analogy between the Physics problem's solution and the algorithm construction, that it is possible to obtain the right result, hoping that its application is not already a failed project.
By virtue that the "V" technique was developed by Bob Gowin with contributions by Joseph Novak, and applied in outstanding researches by experts such as Marco Antonio Moreira, means that all of them, as well as this work, have worked based on David Ausubel's assimilation theory.
There have been educational reforms in different high level institutions and the IPN is one of them, that as a piece of the Institutional Development Plan (IDP), it has proposed a New Educational Model (NME), designed under the constructivist paradigm, an urgent necessity facing globalization.
In educational reforms, the New Technologies (NT) of information have arisen in a vertiginous way during the last few years, as well as new social communication forms that have revolutionized every field, specially in education.

4. Exposition

AT the end of the millennium, Epistemology has opened big debates and developed new theories. This has contributed to the rise of assimilation theory, taking the essence of constructivism, whose base is starting from two movements strongly developed inside modernity. These are the "cogniscitivism", represented by Piaget, and the Vygotsky's conductism, a valid epistemological trend, in which it is evident that the comprehension of the world doesn't come from its discovering but from the principles applied to manifest it.

The cognitive aspects of Jean Piaget's theory had influence on the Ausubel focus, fundamentally with the significant learning by reception theory, in which it is said that the learning occurs when the material is presented in its final form and related to the students previous knowledge.

The assimilation theory fosters the active participation of the student and the teacher as the true bearings; how to teach, teaching supposes listening, talking, not narrating, "because is listening as we learn to speak to the others" (Freire, 1997).

Therefore, the result of the interaction between a new material and a cognitive existent structure is a new and old significant assimilation. In the assimilation process, the relationship between the anchor- ideas and assimilated ones remains at the cognitive structure.

Ausubel makes a reference to the learning statements in the classroom which can't be applied directly, or immediatelyto learning in the classroom could behighlighted:

I) Significant –learning repetition.
II) Discovering – repetition.

In short, it is better that the student has a significant not mechanical learning, a learning by discovering and not by reception in the classroom. Whit this learning, the teacher has and important role since a non traditional teacher is required who is able to be evolutionary, investigative, innovative, interactive respectful and some other characteristics (Freire,2004).

It has already been mentioned that in the classroom, one of the relevant activities in which the learning referred by Ausubel takes part, is the problems resolution, also a fundamental activity in this work, for being the algorithm, its final design. Nevertheless, the Problems Resolution (PR) has neither only one way, nor a solution method. The constant search for techniques to give an original and creative PR has generated solution research methods and "heuristic strategies to facilitate the Problems Resolution" (Moreira, 1999).

The final objective in teaching is that students learn how to solve problems, acquiring the habit of wonder and solve problems as a way to learn (Pozo, 1994).

The Problems Resolution (PR) is a process that must penetrate all curricular design ,as well as provide the context in which the concepts and the attitudes can be learned.

Creativity, for Ausubel, is an essential element in the PR. Likewise, it involves original transformations of the ideas and the generation of new integrating principles. However, it differs in each student, because of their different capacities in the Problems Resolution; that is, the ability to solve them depends on thepeoples' creativity and talent.

The significance of the PR in the programming courses is so big that several researchers have designed different strategies and resources to support students in Computational Problems Resolution (CPR). The algorithm design is characterized by its application, its creative and generating processes, since a particular problem is going to have a solution that will defer depending on the subject's creative and ingenuous capacity.

The CPR compromise students to do activities with a purpose, originating from problematic situations that have been presented to them. These situations require a creative thought that permits conjecture, discovery, invention and communication of ideas, as well as proving these ideas among the critical reflection and the argumentation.

Ausubel, Novak y Gowin have looked for applicable didactic techniques in the construction of knowledge as conceptual maps and the heuristic V. The first ones with the concept

retention support, and the latter as PR help, putting together the conceptual and the proceeding parts.
A fundamental role in the educational CPR in the algorithm's design, among the methodology, is the introducing of the V heuristic tool which is mainly based on two theories that ofNovak education and that of Gowin heuristic. Therefore, we must briefly comment onthese models in order to understand the proposed model cause.

5. The algorithms and their teaching.
¿How can we understand the Algorithms Teaching (AT) and the Algorithms Learning (AL), without considering its evolution in time and space, its place among the teaching and learning technological revolutions?
As soon as computing history is divided into generations for its study, this division is based on technological progresses that permit important advances in the software and hardware fulfillment, in which they take part to delimit the beginning and the end of each phase and its progress.
Within the so called "algorithms phases" their evolution is classified. They're considered as the whole of principles that rules a paradigm and defines the algorithms' semantic and axiomatic characteristics as much as its relation with the hardware evolution.
First phase: Structured algorithms.
It arise with the introducing of control and algorithms data base structures and it's born under the structured programming paradigm(Dijkstra, Horowitz, 1976-1978) (Boom, Jacopini 1996) (Alcalde, García 1992:221-224). In the same way,
Teaching and learning techniques arise as **ascendant programming, descendant, modular, of recursion, turn behind,** as some others.
Second phase: TDA algorithms, CAO, cryptography.
It arises with the introduction of abstract data(Hoare, 1972: 31-42; Lizkov, Zilles, 1974: 50-59), cryptography (Parnas, 1972: 330-336), and the algorithmic complexity application (Baase, 2002; Brassard, 1998; Harel, 2004) on the algorithms analysis and design. The same techniques are used as in the fourth phase, but now the algorithm efficiency is measured.
Concerning the algorithmic complexity, the computing algorithms syntactic in addition to the linguistic and axiomatic part, have been developed by many researchers:
Tarjan (1985), Barry (2003) and Sedgewick (1995).
Third phase: Intelligent algorithms.
Begins with the artificial intelligence and the neuronal nets. Some projects, guided to improve the algorithms learning arise based on tutorials simulators and logical programming. There are also, the learning by discovery(Cernuda, 2005), and the Strategy application in Education(Moroni, Señas, 2005).
Fourth phase: Structured Algorithms.
The computation specialists try to develop efficient algorithms that carry out the emergent necessities as result of the third industrial revolution, in the eighties; involving universities in order to generate computing professionals that support the technological expansion.
Fifth phase: Intelligent algorithms.
The emergence of this last phase has been a key to develop the educational software and virtual innovations in the same field. This has permitted the globalization of education and sharing of advances in pedagogic theories and technological ideas.
If we reflect on the phases mentioned before, we can visualize that the time have elapsed fast for the enormous advances given since the physical construction of the first computer, at the beginning of the forties at the twentieth century. Consequently, we need to train high competitive professionals, ready to fight for the best market's jobs in this globalization era. Student, sure of their training, learning independence and mastery in any kind of problem

presented, must be an excellent professional in order to be a constructive part of the modernization project.
It is relevant to point that to make good use of some technological advances' qualities it is fundamental to have access to good algorithms. They are the essence and the computers' reason of being, because they function starting from these algorithms. Therefore, it is fundamental the way we teach this aspect to the new computing engineers' generations. It's the teachers role to introduce learning techniques as the heuristic V in order to help students in this knowledge construction and develop their CRP skills.
By virtue of that the V technique was developed by Bob Gowin with Joseph Novak contributions and had been applied in relevant researches by experts as Marco Antonio Moreira. It is important to know that all of them have work based on the David Ausubel assimilation theory postulates as well as the Joseph Novak education concepts. This research has its hypothetical bases in the already mentioned theories. However the genesis of this theoretical environment has arisen from the conductivist and cognoscitivist theories, described in the following paragraphs.

6. Methodological propose

The algorithm teaching results hard work, since is not only a concepts transmission to be learned by students. This requires a complex proceeding method in which various factors are to be considered by the docent for its didactic strategy intervene, taking in to account the inherent elements related with the student apprenticeship.
Some primordial aspects in a strategy design for the algorithms teaching, are the conceptual part and the proceed chosen, besides the characteristics that define its classification and evolution. The algorithms teaching consists of identifying what the student already knows related to the algorithmic requirements. Starting from there a new knowledge will be provided, motivating and introducing students to these new knowledges in a non arbitrary way, using for this:

a) The previous knowledge structures as the anchor.
b) Techniques that help the optimal and efficient algorithms' construction work.

It is primordial to bear in mind, starting from the problem's presentation to the students, the process that follows. The solution's abstraction and simulation if it is, among and algorithm, is complex and abstract. Its solution is an heuristic process that needs the right solution model representation as it is represented in the following conceptual map.
With the introduction of this model, the subjects will be involved in the apprenticeship of the algorithm design to the Problems resolution, possibly in Computational Mathematics and Programming (as Programming fundaments, Oriented Programming for objects, Algorithms analysis, Algorithms Design Problems Computational Mathematics using (Cormen, 2001) and Discrete Mathematics). This investigation is initially dedicated to the first semester students and the fifth semester guardianship of the Computation Programming Engineer at ESIME Cu, having as the objective the fostering of the centered apprenticeship on the student among the techniques used such as the Integral Gowin's "V".

7. Proposed Model

It's tacitly accepted that the apprenticeship process of any high level subject (particularly in programming subjects) is susceptible to improve itself by means of teaching techniques. Nevertheless, it is already known that Didactic includes tools but is more ample than that; to begin, we have those techniques that are maybe appropriate but wrongly implanted by the teacher or wrongly applied by the student.

Taking the students inherent elements related to its apprenticeship, the algorithms teaching can be described as the transmission of experience, concepts and the methodologies to make students interested in a significant learning that is not lineal or arbitrary, starting from what the student already knows.

In that case, considering the Ausubel, Novak and Gowin models, algorithms teaching is to identify and know what the student already knows with respect to the algorithmic requirements. In this way new knowledge will be afforded to students, motivating and will introduce them into these new concepts considering their context in which they learn interacting with the proceed and concept elements.
On the other hand, We have to consider the inherent factors to the teacher and students concerning their availability and motivation in teaching as much as in learning. In this proposed model the Ausubel, Gowin y Novak priciples are taking into account, with Moreira observations, constructing this so called "V" under different focuses that try to innovate it:

a) Conceptual focus
It analyzes concepts, variables, laws, Hypothesis and theories that intervene in the process. The student and the professor may rely on conceptual maps or semantic nets for a better comprehension.
b) Methodological focus
It embraces several transformations starting from the problem's definition (questions starting from observed facts and objects) and in the interaction with the conceptual part, the second transformations are made. Also, the methodological construction process takes place (student may rely on **graphs, diagrams, tables and trees**).
c) Algorithmic focus
The interaction of the algorithmic and mathematical fundaments are essential fro the optimal algorithm construction.
d) Instrumental focus.
The viability to process the algorithm through the hardware and software available tools will be taken into account
e) Theorical-practical focus.
It helps us to construct knowledge, since through this focus, concepts are invented or modified. They are also combined with the construction of principles that interact with theories. It is constituted as a flexible and simple method which helps students and professors to catch the knowledge structure. The new construction of knowledge begins with the observation of events or objects among the concepts we already have.Consequently, we understand anything that happens or can be provoked and by object, anything that exist and can be observed.
About its using consideration and its application in this research, we remark in the following lines some characteristics or qualities of this V heuristic technique, considering its support to the teaching and learning process in the computing engineer carrier. So we can say that:

a) It can be used with or without virtual environments, but these last ones may increase their effectiveness.
b) Its importance in science such as Physics and Mathematics has been proved of which problems solution and algorithms construction are of proceeding type ones.
c) It's very interesting since the students and teachers use an individual and collective point of view .

8.Conclusions

If the Gowin's "V" has been useful in Physics, Mathematics, Biology, Electricity laboratory, etc., by conjecture, it should work for other exact science areas, under a postulate where the

teaching techniques influence the apprenticeship process (particularly in the Gowin's "V"). However, as we already mentioned, this hypothesis still has to be validated.

About the relation between the Gowin's heuristic "V" and the teaching- learning process, we must clearly understand it as a didactic technique. Therefore, it meets the postulates, according to what our model assumes, that are done between teaching and learning.

Starting from that,the following should beasked: What is expected with respect to the Gowin's V function applied to the algorithm's teaching?

9. Expected results

The Gowin's "V" is expected to:

- Develop an autonomic apprenticeship with the students.
- Raise their algorithm's design comprenhension level .
- Validate itself as a tool and support in other techniques, increasing its potential.
- Improve the students academic output in the programming subjects, measuring them among evaluation instruments.
- Show its effectiveness or failure for future application in other areas.

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