



Soto & Galván, 2019

Volume 5 Issue 3, pp. 38-50

Date of Publication: 18th November 2019

DOI: <https://dx.doi.org/10.20319/pijss.2019.53.3850>

This paper can be cited as: Soto, B. D. G., & Galván, A. C. (2019). *The Virtual Laboratory in the Analysis of Algorithms as Didactic Strategy*. PEOPLE: International Journal of Social Sciences, 5(3), 38-50.

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THE VIRTUAL LABORATORY IN THE ANALYSIS OF ALGORITHMS AS DIDACTIC STRATEGY

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Abstract

The objective of the present work was to apply a methodology in the teaching of the Techniques of Design and Analysis of Computational Algorithms, for the construction of optimal algorithms in the solution of problems. The methodology followed in the investigation began with the construction and selection of measurement tools. The subject of the Techniques of Design and Analysis of Computational Algorithms in Computer Science is very important, since they are a tool for the optimal and effective solution in the solution of problems through the design of computer algorithms, being necessary to investigate what ideas students have or preconceived ideas through diagnostic tests. This document first describes the methodology followed and the results obtained when applied through the virtual material implemented with Gowin's UVE and the conceptual maps (MMCC) to achieve significant learning in the topic of algorithm analysis. The data recorded at the beginning, during and at the end of the course were analyzed qualitatively and quantitatively in a comparative manner. This research was carried out in the School of Mechanical and Electrical Engineering of the Culhuacán Unit of the National Polytechnic Institute of Mexico in the course of the analysis of algorithms of the fifth semester of.



Keywords

Electronic Manual, Concept Maps, Virtual Laboratory, Gowin UVE. MMCC, Techniques of Design, Analysis of Computational Algorithm, Computer Science

1. Introduction

The present work aimed to apply a methodology for the teaching of Algorithm Analysis and Design Techniques, through the virtual laboratory which was applied in the Algorithm Analysis subject during the August-December 2018 semester under the postulates of the theory of significant learning of Ausubel and Novak. The previous statement is based on the use of the concept maps and the Gowin UVE in virtual environments, in the solution of problems to be solved in the computer lab. Applying the above, satisfactory results were achieved which resulted in an improvement in significant learning and a better school performance in the student in this subject. Considering that the use of new education technologies has allowed a great advance in the teaching-learning process. Working in virtual environments allows both the teacher and the student to have a greater approach that results in a better learning and interest of both parties in education, in addition to the work of the teacher beyond their homework in the classroom. It is a fact that the work of both the teacher and the student to resort to aspects related to the new information technologies (Multimedia, programming languages, application software and Internet), which have revolutionized teaching and learning methods, opening every day new possibilities to expand the coverage with the use of computer areas that have been developed in such a way that they have been key points in graphic applications and animations. These technologies have allowed the development of more innovative pedagogical approaches, which simplify access to databases, distance education, virtual networks and online courses, thus generating new learning, which are better structured, in which the student has automated and directed learning by controlling and directing their educational process, the Internet on the other hand represents a support for teaching and research to innovate both in the classroom and in the laboratory, as well as for the dialogue between teachers and student through email, facilitating tutoring and face-to-face counseling.

The concern to achieve quality in the practice of teaching has stimulated the search, design and implementation of teaching materials in virtual environments that support the teacher in their homework, and the student in their learning process. It is expected that Higher Education institutions will respond to new productive and social needs, wrapped in a renewed technological culture, which should be based on the comprehensive reform of their educational models, assuming

original visions regarding the need for change that imposes global competition, the intensive use of digital media as a new tool in the educational field.

All of the above follows the existence of a need to create flexible, versatile and multidisciplinary education opportunities closely linked to innovation and technological advancement plans, as well as an emerging knowledge society, considering the new emphasis on education such as learning to know, learning to do, learning to live and learning to be.

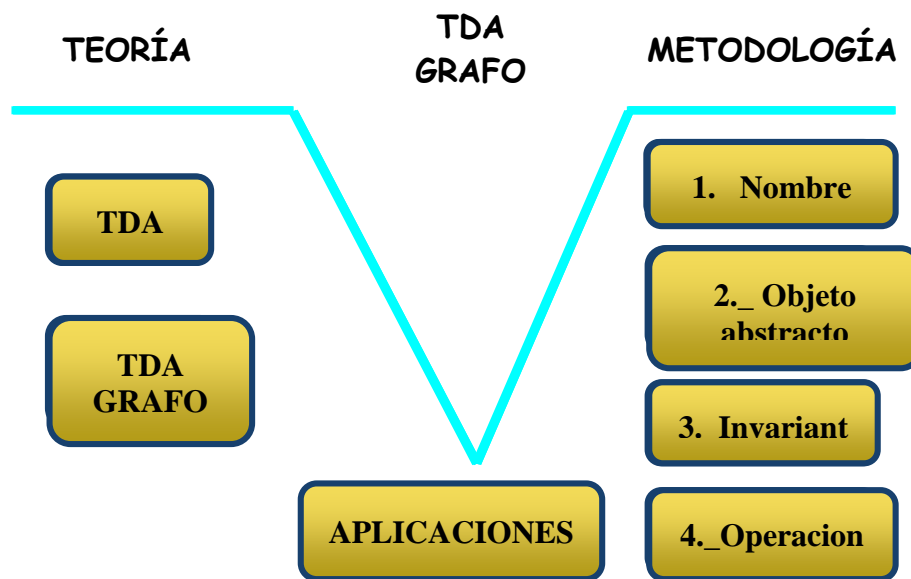


Figure 1: UVE TDA Directed Graph

The laboratory associated with the subject of algorithm analysis represents the most important part of the learning of the subject since it is the verification of the theoretical part, it is where the student develops his skills of both ingenuity and creativity and ideas, where his contribution goes beyond a simple class exercise where you can make simulations of solving real problems and where the student can visualize both the theoretical content and the result of their applications. This virtual teaching material is related to the electronic notebook of the students in the theoretical part, the two materials are closely related because the practice and theory of a subject are complementary, where knowledge is not enough theoretical so that student learning is

meaningful.

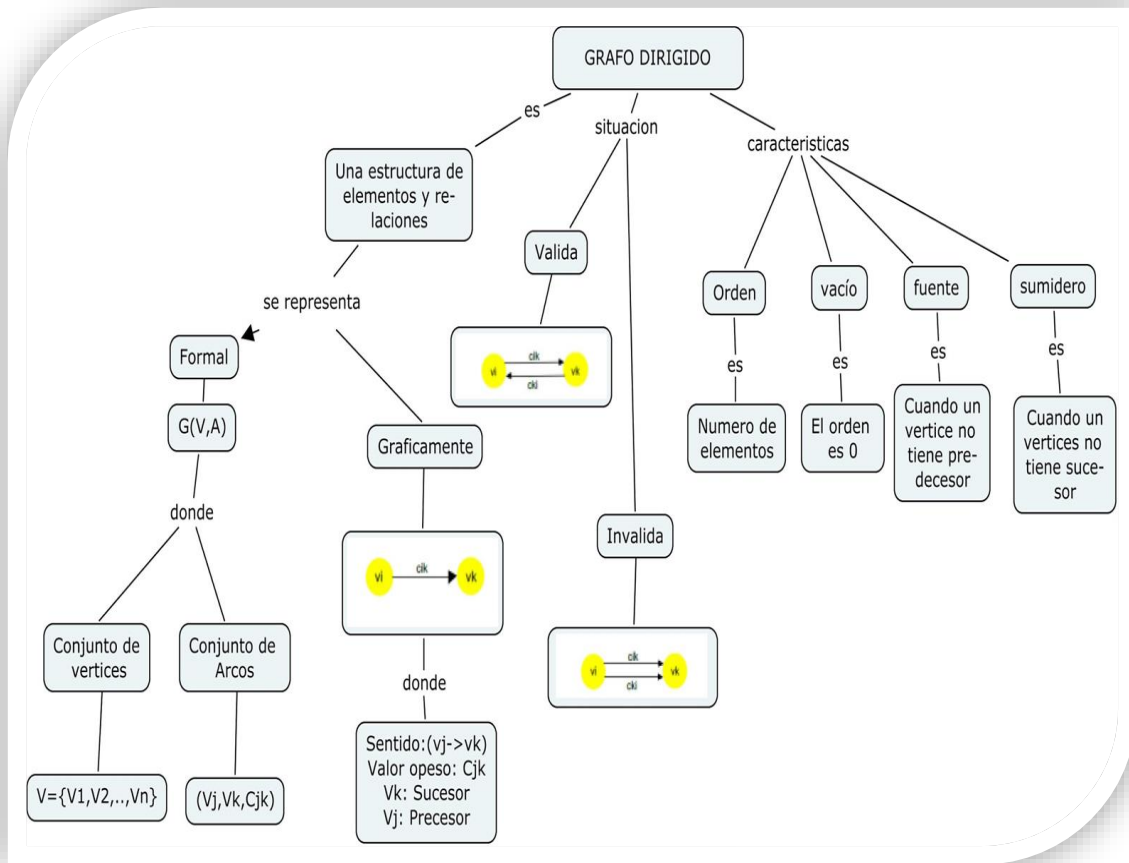


Figure 2: UVE Directed Graph

The figure 1 shows a Gowin UVE built by the student on the subject of directed graphs, where the theoretical and methodological part was evaluated as well as the definition and analysis of the problem each part of the UVE has weighting points for an evaluation of the student's learning about the subject and the understanding to integrate the theoretical part and the practical part in solving the proposed problems.

Figure 2 shows the concept map with respect to the topic of directed graphs as well as figure 2, weighting points are taken, with respect to the construction of the concept map. Evaluating the hierarchy of the concepts and the link words that give a logical sense of learning the subject.

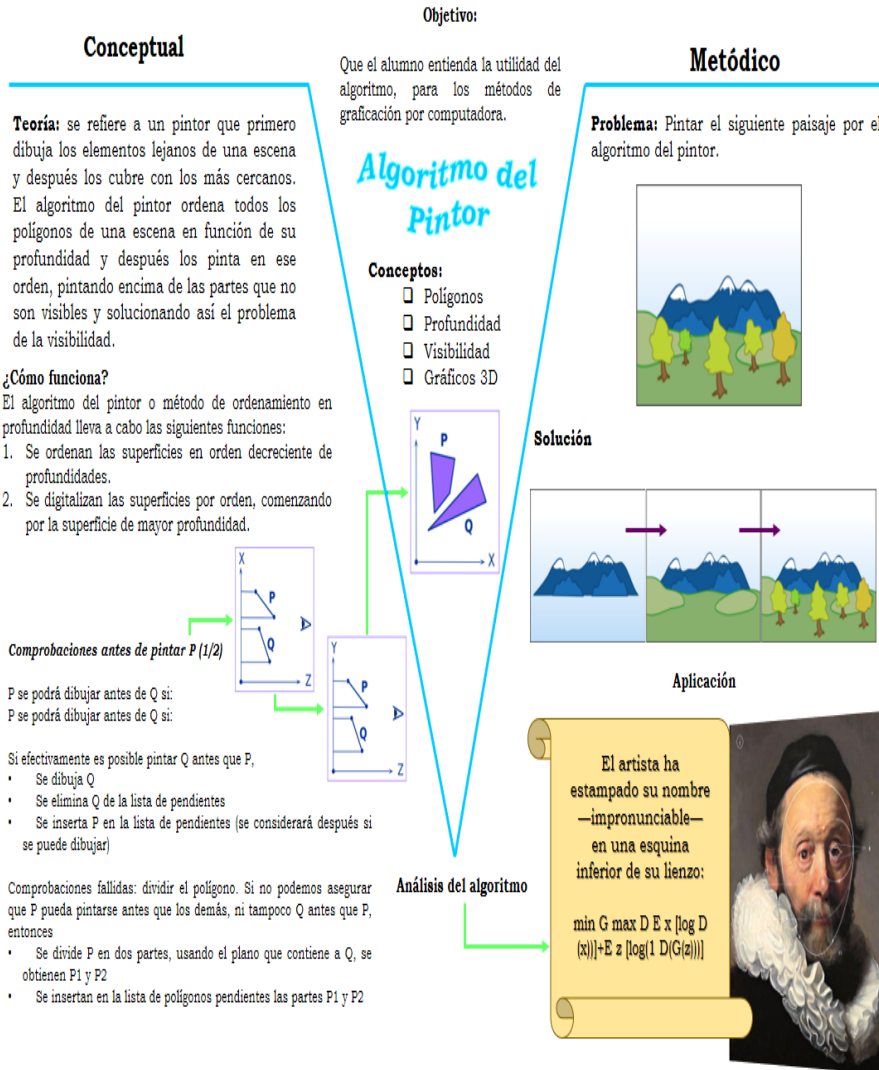


Figure 3: Gowin UVE-1 Built by the Student

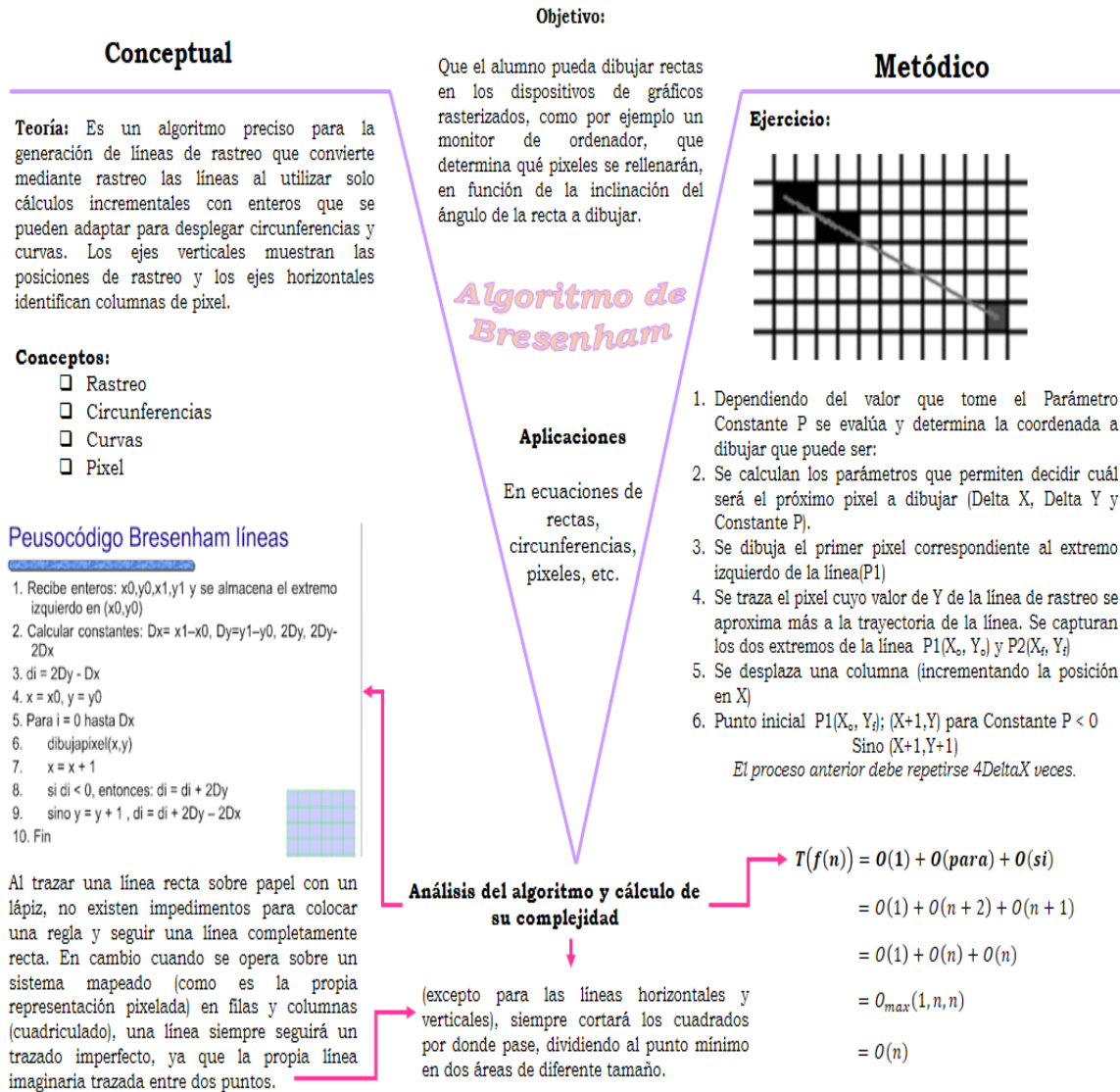


Figure 4: Gowin UVE-2 Built by the Student

The subject of algorithm analysis is of great importance for being the mathematical part of computing, both for its applications and for the technological advances that have been made in this area, since it is the beginning in the design and analysis of the algorithms of the students who go to the middle of the computer engineering career, then the bases, skills and abilities acquired in this subject will be relevant to develop efficient and optimal algorithms using optimization design techniques, knowing that this science has great social impact and approach to the general public. The term of algorithm analysis is the study of the resources of time (time complexity) and space (spatial complexity), which occupies an algorithm when executed. Computers have become a powerful tool to produce images quickly and economically. There is no area where it is not possible to apply computer graphics with any benefit, so the use of these has become widespread. Today,



computer graphics are routinely used in various areas, such as science, engineering, business, industry, government, art, entertainment, advertising, education, training and graphic presentations.

2. Methodology

In the practical part that is the laboratory, it supports the teacher in several lines by virtue of the characteristics and parts of a virtual laboratory to achieve significant student learning. The parts that comprise it are: diagnostic knowledge test, solution to the diagnostic test, support tutorials for the reinforcement of the previous knowledge that the student must have to integrate the new ones, links to the teacher's email in various parts of the page of the subject where the material was included: theoretical content of each practice, syllabus, basic bibliography, bibliographic suggestions, proposed projects, simulation of solution to real problems through software developed by the student, examples and solved exercises and proposed exercises (including the use of concept maps and the heuristic UVE). The work shows four examples of the concept maps and the GOWIN UVE constructed by some of the students, of reports of the practices carried out in the computer laboratory.

This material has as background the didactic material built with interactive conceptual maps and the virtual heuristic UVE used as learning techniques in the subjects of Programming Fundamentals and Data Structure, these same techniques form the basis of the didactic material developed, both in the subjects of content of the subject as in the practical part of it in the examples and the proposed exercises.

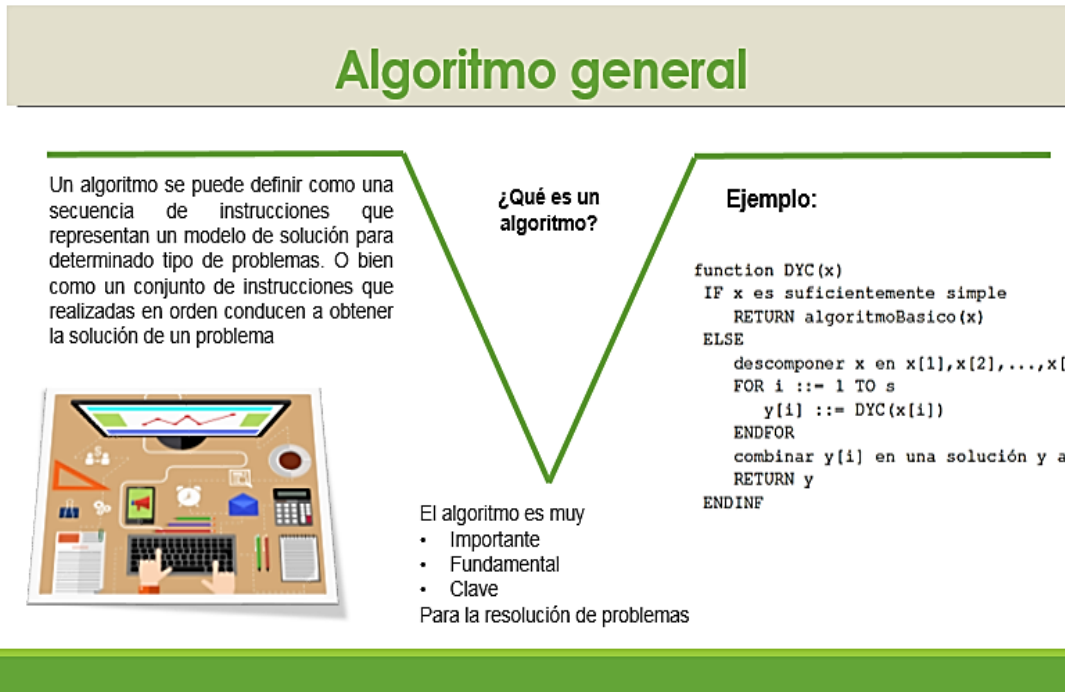


Figure 5: Gowin UVE-3 Built by the Student

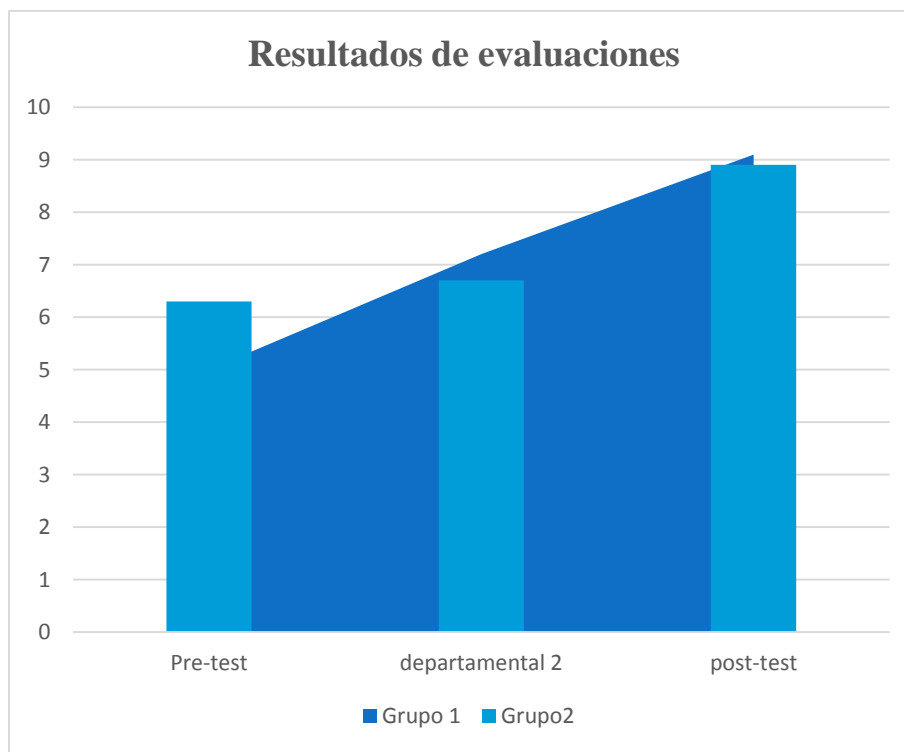
1. At the beginning of the semester, the student will have the virtual laboratory material.
2. It is explained how to use material of the virtual laboratory.
3. The student has access to the virtual laboratory material.
4. Send to the teacher via email doubts and solution to the problems raised through algorithms exchange solutions with their peers.
5. Teacher advises, coordinates and reviews exercises performed by students, supported by the virtual laboratory material.
6. When sending the answers and the evaluation of the solution given by the students to the problems, according to the result, suggestions are given:
 - Access to the tutorial of C.
 - Access to the knowledge review class with examples and proposed exercises.
 - Examples solved using learning techniques.
 - Exercises proposed with odd solution at the end of each topic.

3. Results

The material of the virtual laboratory. It was a great help to both the student to achieve meaningful learning and therefore to have a better performance to school, as well as to the teacher for their support in the various functions that he performs as coordinator, tutor, guide, among others for the benefit of good student performance, preparing it for self-learning not only in this subject but in others, but especially for his performance as a professional.

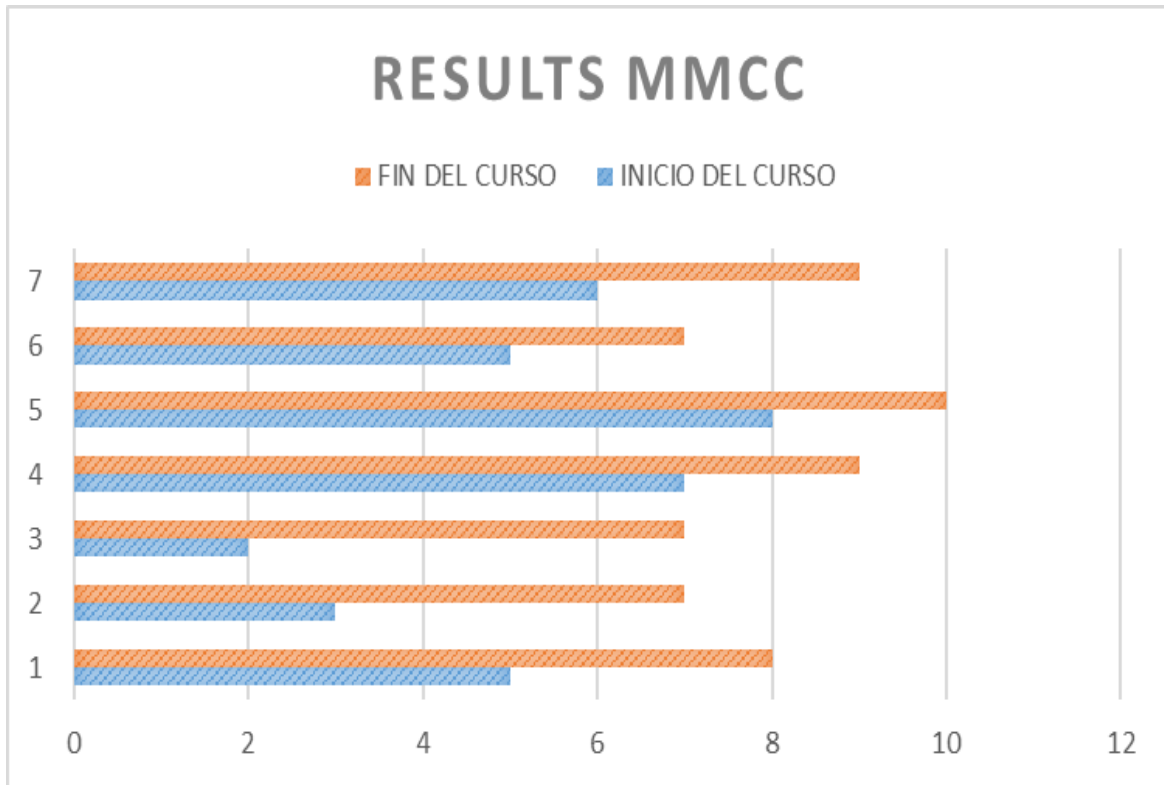
- To achieve the integral formation of the student to follow up through virtual instruments that will help in this task.

- Better academic performance in the participating groups



Graph 1: Pre-test and Postest

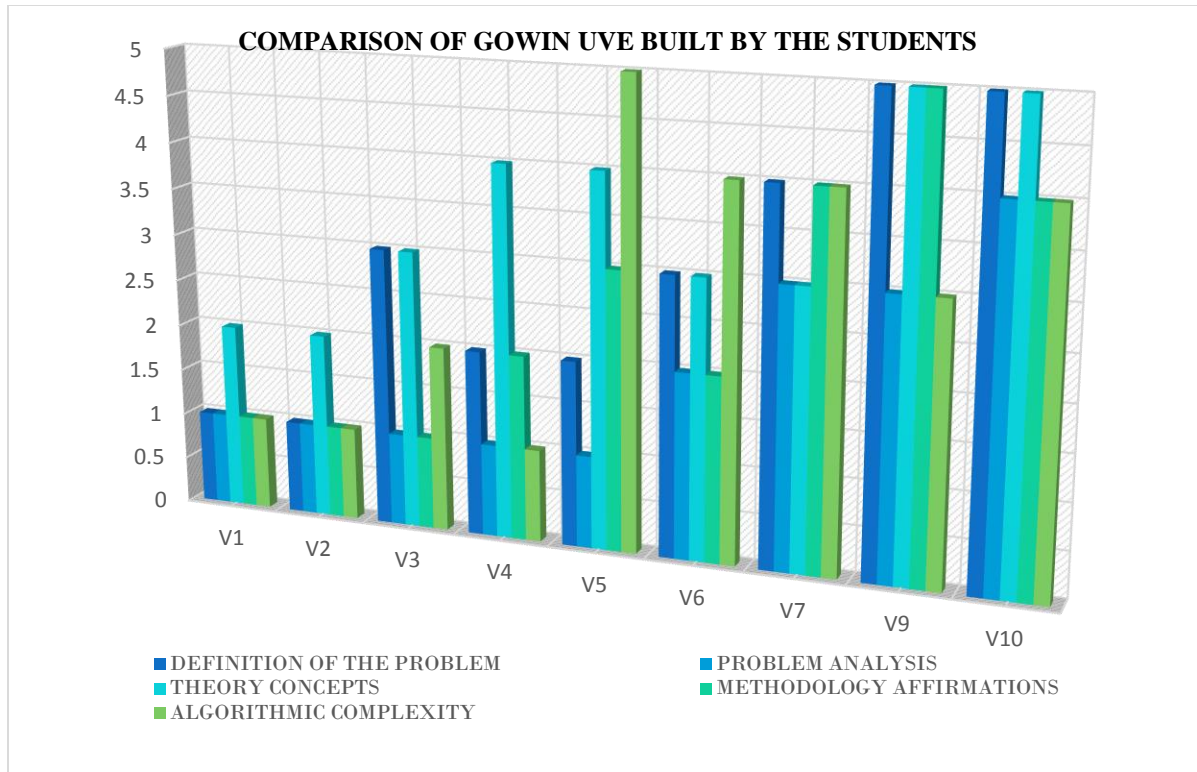
The graphic 1 shows the conceptual and practical progress of the students, Graph one shows the results obtained when applying a diagnostic test at the beginning of the course and another at the end of the course, in the departmental exam, this evaluation included the analysis of the UVE and the conceptual maps developed throughout the course in the laboratory of calculation.



Graph 2: *Evaluation of Student Concept Maps*

In the Graph 2 Gowin's V used in both the computer lab and the theoretical class was developed based on the theory of meaningful learning (Ausubel, 1983), as a methodological resource that allowed us to see the process of knowledge construction as well as the research and evaluation, in a dynamic and flexible way, which can be considered "... research as a way to generate structure of meanings, that is, to relate concepts, events and facts" (Moreira, 1977: 7), which are elements of the structure that arises. Gowin and Novak touch on the theme of the purpose of any educational event, which is to develop cognitive faculties in students, in this way the teacher must resort to implementing instructional resources that help the elements involved such as teacher, student, curriculum, medium, authorities and evaluation in all educational events must interact to achieve progress in learning.

The points of the concept maps from 1 to 5 make reference to the fact that both the student was able to rank the concepts of a certain topic, to evaluate the progress in learning the topic to be treated.



Graph 3: Evaluation of Student Goein`s UVE

In relation to graph 3 it was observed that el analysis of Gowin`s UVE built by students allowed us to evaluate the construction of students' knowledge and the way theory and practice interact. The use of the method used reverses the Piagetian statements about reasoning, since it assumes that students of any age may appear to operate at the concrete level or at the formal level, depending on how appropriate their relevant conceptual frameworks are. We assume that students think rationally, and that almost all of them are capable of using what Piaget calls developed formal Thinking, Provided It Has an Adequate Structure of Relevant Concepts. For This Analysis They Built Two Observation And Evaluation Sheets.

4. Conclusions

The virtual laboratory material was of great help to both the teacher and the student and represents a compilation of experiences of application of different evaluation instruments such as diagnostic tests and pre-evaluations, of the use of learning techniques such as concept maps and the Gowin UVE in electronic environments, used in the teaching process of other subjects such as data structure and analysis of algorithms in which very good results were achieved. From the above, it can be concluded that this material will be very useful because it is more complete and brings together many suggestions and contributions from students of some parts of the teaching material of the experiences in previous semesters, however nothing Perfect or unquestionable, it



may have deficiencies and points not considered that will be integrated at the time of detecting its failures. It is in the process of building the instruments for evaluating and monitoring the operation of the material, as well as the final results in the teaching-learning process, and the integration of the practical application of the theory.

Within the future works, comparative studies of learning through these heuristic techniques, not only in the computer lab, must be applied virtual and face-to-face in both group and individual tutoring work.

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