Didactic Strategy for the Teaching-Learning Process of Discrete Mathematics as Foundations in Computational Intelligence

Estrategia didáctica para el proceso de enseñanza-aprendizaje de Las Matemáticas Discretas como Fundamentos en Computacional Inteligencia

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Abstract—The teaching strategy presented aims to provide the contextualized learning computational intelligence in correspondence with the needs of the information technology students. This proposal is the output of a theoretical model that structure the process of teaching and learning of computational intelligence, from the dialectical relations between its components and it is manifested as a set of actions structured in three stages, defining their respective goals to transform the work, being done in traditional way, towards new demands of renewal in the continuous improvement that is required, in correspondence with the needs that the learning of mathematical content has for the College student, social significance and practical value. Assumes the contextualization as a contextual approach to the teaching of computational intelligence. The application of the teaching strategy in teaching practice confirmed its relevance, feasibility and effectiveness through the use of empirical methods: evaluation by expert criteria, consultation with users and the pedagogical experiment in its pre-experiment variant, demonstrating favor the contextualized learning of the subject computational intelligence in the information technology students.

Keywords—Contextualized, Strategy, Process.

Resumen—La estrategia de enseñanza presentada tiene como objetivo proporcionar el aprendizaje contextualizado inteligencia computacional en correspondencia con las necesidades de la información estudiantes de tecnología. Esta propuesta es el resultado de un modelo teórico que estructura el proceso de enseñanza y aprendizaje de la inteligencia computacional, desde la dialéctica relaciones entre sus componentes y se manifiesta como un conjunto de acciones estructuradas en tres etapas, definiendo sus objetivos respectivos para transformar el trabajo, que se realiza en manera tradicional, hacia nuevas demandas de renovación en la mejora continua que es necesario, en correspondencia con las necesidades que el aprendizaje de contenido matemático tiene para el estudiante universitario, importancia social y valor práctico. Asume el contextualización como un enfoque contextual a la enseñanza de computacional inteligencia. La aplicación de la estrategia docente en la práctica docente confirmada su relevancia, viabilidad y efectividad mediante el uso de métodos empíricos: evaluación por criterios expertos, consulta con los usuarios y el experimento pedagógico en su variante pre-experimento, demostrando favorecer el aprendizaje contextualizado del sujeto de inteligencia computacional en los estudiantes de tecnología de la información.

Palabras Clave—Contextualizado, Estrategia, Proceso.

INTRODUCTION

Regardless of the different meanings that possesses the term strategy, in all of them is to present the reference to can only be established once the objetives have been determined to achieve. To allude it, they tend to use different names.

As a result, "the strategy is valued as the inter-relationship of a set of 2 tactics"(Addine et al., 2004). Among several criteria and interpretations contained in the educational literature on the subject, this research assumes the term strategy as a particular form of result of educational research, in which, as well as highlighting the intention in the transformation of the educational management by scientific means, refers to the various functions that can take part in the educational field.

The teaching strategy is presented as the representation of the educational practice in the model, to contextualize the teaching-learning process of the subject computational intelligence in the career technologies of the information of the University State of the South of Manabí. It is manifested as a set of actions to short, medium and long term. Its essential qualities are expression of the result, to a level of practical implementation, of the dialectic interactions between the components of the model of equal nature. It is assumed

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contextualization as a contextual approach to the teaching of mathematics, considered to be the process which states the provision between the whole and the parts in a given context, since the order of composition and fusion of elements from the integration and interaction to form a mathematical content, that becomes interdisciplinarity as an immediate and effective expression to carry out the contextualization (LÓPEZ and MONTOYA, 2008).

The overall objective of the teaching strategy is transform the deployment of the teaching and learning of the subject computational intelligence process in information technology career, to achieve a contextualized learning, with emphasis on the use of the information technologies, from the relationships between the components of the theoretical model on which it is based. With such estimations, it is convenient to consider "the teaching strategy as a construct which, with its implementation, output "practical model çontextualized learning process referred"(Alcaraz Rodríguez, 2015)). aims to solve the existing contradiction between the need for learning in contextual social significance and traditional teaching that takes place in the subject. The teaching strategy has permanent orientation towards the continuous improvement of the quality of learning, by the existence of a need, which is determined by a diagnosis, is deployed to implement the plan of action elaborated, in three stages, which express the existence of hierarchy levels about the subordination of its elements components; therefore, the overall objective is specified in the expression of the result of the integration of the stages. To orient it toward the contextualized teaching-learning process of the subject computational intelligence in the career information technologies, with interdisciplinary approach, combine educational needs, related to the content, which concur in students and the potential that the subject in question for the contextualization.

MATERIALS AND METHODS

Structure of the didactic strategy for the teaching-learning process contextualized of discrete Mathematics as foundations in computational Intelligence

The teaching strategy that is argued is comprised of four essential aspects: the premises, which function as General requirements for their design and implementation; the characteristics; the actions of contextualized teaching-learning process, organized by stages its logical consecutive and mutual conditioning; and interdisciplinary learning tasks, supported by exercises and contextualized problems.

The premises are conditions requiring the teaching strategy for application, but act outside the process, which are considered the general and particular premises. The following general assumptions have been established (Levin and Peres, 2017).

- Domain of the labor of the students of the career and psychological characteristics information technologies.
- Domain of the results of previous learning of students.
- Preparation of students, in terms of knowledge and skills of the received subjects, with emphasis on those that correspond to the area of exact sciences and computer sciences.

- Preparation of teachers in the theoretical, methodological, and investigative aspect in subjects concerning information technologies career.
- Availability of teachers to take the teaching strategy and, from it, execute the actions of contextualized teaching-learning process.
- Knowledge of organizational and structural aspects requiring the contextualized teaching-learning process of the subject computational intelligence, for the implementation of the teaching strategy.

It is important to understand that there are also premises with a particular nature, which occupy a significant place as follows: The teacher must:

- Have alternative resources depending on the demands of the process, to allow act strategically, from the demands of students, based on own interests and labor needs.
- Be equipped with methods of teaching in the subject computational intelligence and their specific procedures to contextualize the mathematical content in each one of the units.
- Achieve a full of reasons communication process, so as to ensure a necessary training environment, through learning tasks that carriers of elements that make grow the personality of students and, consequently, lead to the fulfilment of the objectives.
- Raise students learning with objective, economic and social tasks to execute the process of teaching-learning contextualized in order to demonstrate the usefulness of the content through interdisciplinarity.
- Ensure that the student is the center of the learning process, working individually or in equipment in the solution of the tasks and to feel the importance that it and its surroundings have the educational process.

The premises influence the characteristics of the teaching strategy:

- Can accommodate diversity, which makes it practical and objective.
- Fits the moment.
- Power use of interdisciplinarity in the teaching-learning process, which makes it integrated and integral.
- Central authorities the Professor and students, constitute it what humanist makes it.
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Stages for the development of the contextualized learning process computational intelligence career information technology subject:

First stage: Comprehensive diagnosis of contextualized learning.

Aim: To know the context of students and measure their level of knowledge into contextualized learning tasks solution.

Aid levels range from the most elemental, that might be questions, phrases from support or stimulation, to provide mo-

re precise guidelines towards the achievement of intermediate stages in its work, until arriving to the end.

All of this sets the stage for the contextualization of the content of the subject computational intelligence, which focuses on planning contextualized through a programmed of action with a set of activities aimed at the satisfaction of needs indicated in the diagnosis, to include them in tasks that are planned.

Actions:

- Study and analysis of the documents governing the work with the subject computational intelligence in the career of information technology in teaching and methodological aspects [analytical program, syllabus, methodological guidelines, guidelines for working with the subjects, characterization, psychology students, analysis of the objectives of the subjects, objectives and content units (System knowledge) and objectives that transcend to other semesters] to be able to contextualize the content.
- Study and systematization of the theoretical basics about interdisciplinarity and the trans-disciplinary, its use in the contextualized teaching-learning process, with an emphasis on integration from learning tasks.
- Synthesize the characteristics that should be learning tasks so that they get the interdisciplinary knowledge, as well as the various indicators that can be used to measure the effectiveness of these.
- Diagnose students to learn: potentialities, constraints, conceptual domain, habits, skills values and integral general culture (have in the learning of the subject computational intelligence in information technology career), as a reference.
- Observe, discuss, and carefully record the different manifestations of the students in learning situations, to learn:
  - Relations of students in its context.
  - Strategies that students use to learn.
  - Significance that has learning for life.
  - Determine the levels of aid necessary, related to the specific educational needs of each student.
- Specify appropriate assurance of support through the strategies of teaching and learning, which are mediators of learning and have an internal structure that are manifested in:
  - The conditions of the planning control; this level of support is aimed at the appropriation of the object, determined the time and other conditions that need to do this, here are designed algorithms and analogies.
  - Implementation of the planned actions, in this level is experienced and reproduce models, i.e. checks whether the conditions laid down above are effective or not.
  - Transfer, is the level at which the student is able to transcend a specific location from the generalization of the knowledge and skills to similar situations; for the teacher, this is a stage of control, is the passage of the development zone close to the area of current development, namely the manifest.

Diagnosis allows you to measure the level of knowledge of students in the solution of contextualized learning tasks, making it easier to determine your location by levels of cognitive performance, which in the subject computational intelligence, particularly in information technology career, is assumed:

Level I: The student's ability to use basic operations of instrumental character, this shall identify, describe and interpret the concepts and essential properties on which rests the subject computational intelligence. At this level are considered students who are able to resolve formal exercises eminently reproductive (learn to identify propositions, determine its truth value, know the logical connectors. Starting from the propositions and their truth value, perform basic logical operations such as: negation, conjunction, the disjunction, conditional, the biconditional, to conclude whether it is of tautologies and contradictions and contingencies; know determine sets by extension and description as well as for the realization of the basic operations concerned a: union, intersection, complement, difference, symmetric difference and set power; (knows and identifies the positional number systems such as: binary, Octal and Hexadecimal, knows the elements and characteristics of graphs, their components, classification and mathematic-computational representation); that is to say; at this level are represented those contents and skills that form the basis for understanding mathematic- computational.

Level II: The student's ability to establish conceptual relations; in addition to recognize, describe and interpret concepts, should be applied to a situation and reflect on its internal relationships, situations math that are framed in so-called routine problems that have a known solution path, at least for the majority of students who, without being properly reproductive, neither can be considered production globally. This level is the first step in the development of the ability to apply mathematical problemsolving computational structures (student systematizes and delves into the Decimal system, performs conversions between the different positional number systems, as well as the basic calculus operations and its application in computing, in the design of intelligent calculators and use in circuits; optimizes Boolean expressions , your application, the determination of mini and maxi terms and solve problems integrators.

Level III: The student's ability to solve problems, so you must recognize and contextualize the problem situation, identify components and interrelating them, establish solution strategies, substantiate or justify what has been done; via is not generally known to the majority of the students and the production level is high. At this level students are able to recognize complex mathematical structures and to solve problems that do not involve the use of strategies, procedures and routine algorithms, but they allow the staging of strategies, reasoning, and non-routine plans requiring the student to bring into play their mathematic-computational knowledge. The student will solve computational problems using the basic techniques of propositional logic, set theory, using its laws and diagrams. You will develop skills of calculation for converting between positional number systems, basic operations, as well as the application of the numerical systems in computer. Apply

the basic concepts, theorems and properties of the Boolean algebra, to construct logic circuits and optimize expressions inclusive. Apply the basic concepts of graph for solving problems related to the computer area, travel, search and sorting on graphs and trees.

Actions:

- Rating contexts and conditions for the performance, with help, non-imposition, and comes from:
  - The classification of information that encourage (unforced) contextualization of the mathematical content.
  - Organization of the content derived from the information classified according to priorities and interests for the solution of learning tasks, in correspondence with the dosage of the content of the program with a vision parallel integration with computer programming.
  - Stimulation for contextualized learning, oriented to achieving the necessary motivation in students for the development of all and each of the integrated learning tasks and inclusive.
  - Orientation towards the objectives (action, media, tasks, significance and importance)
- Contextual planning activities, should be taken into account: theoretical systems concept, objectives, skills, media and bibliography for contextualized learning, content, independent work and tasks for the evaluation of learning, materialized from interdisciplinary learning tasks that constitute the essential oneness.
- S choice and adequacy of the content from the documents analyzed and studied in the first stage and its relationship, through learning tasks, with the rest of the interdisciplinary content, for which it is necessary to bear in mind that the task that is plan is:
  - Realistic socio-labor: who have practical utility and social meaning.
  - Complex nature (interdisciplinarity).
  - Open character.
  - Demanding to work individually and collectively.
  - Demanding the need to use multiple qualitatively different sources of different areas (inter - trans-disciplinary).
  - Obligation to employ and develop procedures and complex resource demanding and diverse.
- Form interdisciplinarity from a harmonious and coherent system which make it possible to establish targets to achieve with the task of learning a whole.
- Promote actual interactions between subjects, i.e. a true reciprocity and Exchange, in which the subject computational intelligence assumes a major role.
- Set relationships and interactions between propositional logic, the theory of sets, binary arithmetic, Boolean Algebra, graphs and trees. Solve problems related to the practical life and in which used the experiential context of student-related data (when falls, for example, to the first songs of the first half and extend it on to the other semesters from projects knowledge integrators).

- Formulate and solve problems in which applications of these contents to specific situations, in addition to motivate students, contributing to their comprehensive training and in which outcomes economic, social, territorial, national and international; as well as phenomena and Scientifics-environmental processes, are displayed display which will use the system of previous knowledge, which is necessary work with quantities of magnitudes and geometric relations with graphic representations using science resources computer.
- Promote the text elaborated by the teacher, to respond to the proposed objective, which must comply with the following indicators:
  - Drafted in a clear and simple language (successful use of the mother tongue).
  - The data must be extracted from the social context, relationship between the given

  and the searched, unknown, affordable solution to the half and take a message to the student that will allow their motivation and interest.
- Included in the tasks of learning exercises and problems that correspond to the three levels of performance: the reproductive, application and creative, as well as questions true or false, complete and questions closed or multiple selection, not open or development questions are discarded. It is necessary to present different routes in the formulation of the questions students.

Some examples of exercises contextualized:

1. Be the following logical function (Figure 1):

$$z = (a + b).c + (a + c).\bar{d}$$

Figure 1. Logical function.
Source: Prepared by the authors.

   a) Build the values table corresponding.
   b) Obtains the logical circuit that is really derived of the values.
2. Starting from their knowledge about Graphs and Trees, analyze and respond: In the computation laboratory II, it is required to connect 8 computers in net using 12 cables, so that each computer is connected to other.
3. Can one make in several ways? Make three different proposals at least completing the given demands.

RESULTS AND DISCUSSION

1. Methodological guidelines for the development of contextualized learning tasks:

The orientation of contextualized learning tasks, the professor, as part of the collective, will consult with each of the rest of the teachers the way will link and integrate the contents, so that necessarily analysis and discussion in the group, because its objective is to achieve a stronger link between the subjects of the semester in question as well as promote the deepening

of knowledge in order to achieve the increase of the integral general culture and enhance meaningful learning. Teachers can develop exercises, problems, and learning tasks, taking into account the requirements laid down in the present teaching strategy, as conditions for success in learning.

These tasks, which should form a system, should conceive from interdisciplinarity, where Professor needs a preparation which, in turn, will be necessary for the preparation of the system of classes, and vice versa.

Be able to plan the class system will require that you prepare yourself on how use the interdisciplinarity for the conception of their kinds of consolidation and the system of learning tasks; It also has to consider that labor tasks go beyond these relationships and establishing trans-inter-disciplinarily. Methodologically, reveals the need for the use of learning tasks, allowing establish mathematical cognitive apprehension.

The relationship between the contextualization of learning tasks is demand for a proceeding that conditions a custom apprehension of the subject computational intelligence and a personalized systematization.

In this proposal, the mathematical content is marked by the methodological system of class analysis, taking into account the fundamental components of the didactic: the aim and the content from which can, in turn, determine the method, organizational forms, media and evaluation, interwoven with the practical resources offered by the subject. For this reason, in all methodological analysis of a class or class system are the following, in order of priority (Alcaraz Rodríguez, 2015).

- Definition of the objectives and the dosage, from the logic of assimilation of content- based intra - transdisciplinary.
- Selection of the types of classes corresponding to the unit or the subject.
- Determination of the potentialities of the content for output to the General objectives of the semester, the basic elements mentioned in the guidelines for working with the subjects, to comply with the comprehensive training of students in their context.
- Definition of methods, procedures and means of education that can lead to the student the active pursuit of knowledge and its practical application and evaluation forms.
- Transdisciplinary conception of learning inters tasks - with predominance in the application of the information to the solution of the problems of life, through the use of computer resources, and audiovisual materials that support the content in question.

2. Third stage: regulation and evaluation of the learning context for the subject computer career information technology intelligence

Objective: To evaluate the efficacy of each of the previous stages and their impact on the mathematical knowledge in interrelation with the cognitive realization and the level of contextualized learning for students of the subject computational intelligence in the information technologies career.

This stage takes place parallel to the remaining, evaluates the partial operation of all own implementation from the components of the model. Actions conceived in each one of the stages are updated as systematic and partial assessments serve as a feedback to refine them.

Evaluation should be individual, oral and written, taking as reference the essential qualitative and quantitative changes which occur in students and to show in mathematical knowledge that they acquire.

Regulation, according to the diversity, will be led to the cancellation of the weaknesses and openness to growth, Exchange, custom help, stimulation, guidance, explanation, demonstration or illustration, constraints of the systematization and apprehension of mathematical content in connection with life.

Actions:

- Assess the impact on the mathematical knowledge of contextualization.
- Take into account the nature of the objectives and content system that receives or has received the student of this level in the different subjects, with emphasis in the area of exact and computational sciences to the design of learning tasks.
- Use the preceding content, with amplitude in the conception of the task and the work of the student to comply with it. Its impact must manifest itself in the cognitive realization that modifies the mode of action of the student.
- Solve the tasks of learning contextualized by all possible avenues: means that all the ways that students can use must be sought, whether arithmetic, algebraic, geometric, or otherwise that may in fact involve all or some of the others.

It should be noted that, parallel to the accomplishment of the task individually, must be achieved that the student working in small groups or teams, in which each have their individual responsibility and at the same time that all respond collectively to work, established systematic exchanges to involve them in the design of the system's activities.

- Validate the task of learning contextual. This validation must be carried out before the presentation of the tasks students and aims to avoid any irregularities therein. Keep in mind also that:
- With the task of learning contextualized, control and evaluation must take into account the outcome, how thought the student to give you solution and how errors that may be committed can serve learning not to commit it under similar conditions.
- Also, the evaluation can relapse in his teammates or the self-assessment of their work.
- Objectives have to be more precise, they include levels of cognitive performance to be achieved in knowledge at each time of the task; as the objectives constitute criteria for testing and evaluation of the results of the work carried out.
- Assessment is, broadly, the process by which compares the results of the work done by the students with the objectives to determine the efficiency of the contextual learning task and, consequently, reorient the work and

decide whether it is necessary to work on these goals or part of them, with all students or some, whether or not the process that was followed in the work was the most suitable. It has essential purposes, checks and assesses the extent in which the objectives are accomplished and determines what immediate guidance should be given to the teaching-learning process.

- An essential component determines its own degree of efficiency, has objective, systematic, character of continuity and concludes with a value judgment. Is a high level of education if it implements and properly applied.

Figure 2. Didactic Strategy for the Teaching-Learning Process Contextualized of Discrete Mathematics as Foundations in Computational Intelligence.

Source: Prepared by the authors.

CONCLUSIONS

The teaching process of teaching-learning strategy contextualized of the computational intelligence in the information technology, race course is configured as an application and instrument because of its transformative character of reality becomes a construct of conducive practical value to improve teacher performance and the learning of the students in connection with life. With the application of the method of expert criteria, criteria of users and the pedagogical experiment in its pre-experiment variant, found consensus to ensure that the teaching strategy of the contextualized teaching-learning process of the subject computational intelligence in information technology career is likely to be applied in similar institutions. The didactic strategy, which in its consistent implementation will bet improving the contextualized teaching-learning process of the subject computational intelligence in information technology career is posed in this way.

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LÓPEZ, E. and MONTOYA, J. (2008). La contextualización de la didáctica de la matemática: un imperativo para la enseñanza de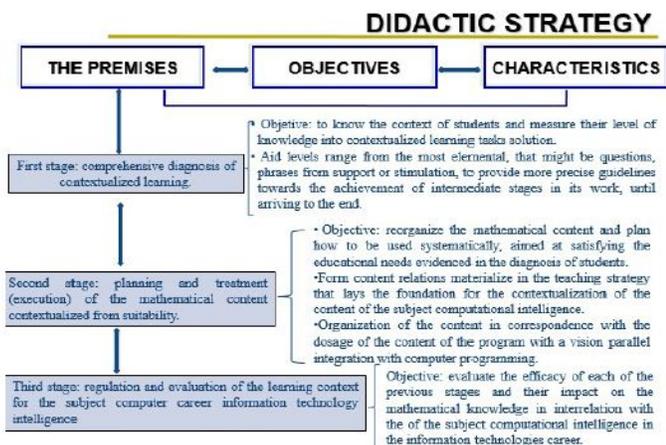l siglo xxi. *Universidad Oriente*, 13.