UNIVERSIDAD DISTRITAL FRANCISCO JOSÉ DE CALDAS

Visión Electrónica

Más que un estado sólido

http: revistas.udistrital.edu.co/ojs/index.php/visele/index

VISIÓN ELECTRÓNICA

A CONTEXT VISION

Technology applications to calculus

Aplicaciones tecnológicas al cálculo

***Orlando García Hurtado*[1], *Harold Vacca González.*[2] *Henry Buitrago.*[3]**

INFORMACIÓN DEL ARTÍCULO

Historia del artículo:
Enviado: 12/12/2016
Recibido: 06/03/2017
Aceptado: 20/07/2017

Keywords:
Methodological design
Problem solving
Technology tools

Palabras clave:
Diseño metodológico
Resolución de problemas
Herramientas tecnológicas

ABSTRACT

This paper presents a proposal towards the betterment of mathematics teaching quality with an emphasis in problem solving using information technology, based on a learning methodological design that allows reaching objectives and standards, so that students acquire elements to evaluate their cognitive development through their integral education. To achieve this, the elaboration of support material will be shown; this material is centered on the student, on theories of learning and on a set of actions and didactics procedures using technology, which will produce a strategic learning design. The technology tool introduced in the student education plan serves as a means to visualize concepts, explorations and self- evaluations as a fundamental part in the development of the methodological model.

RESUMEN

Este trabajo presenta una propuesta para mejorar la calidad de la enseñanza de las matemáticas con énfasis en la resolución de problemas usando tecnología de la información, basada en un diseño metodológico de aprendizaje que permite alcanzar objetivos y estándares, para que los alumnos adquieran elementos para evaluar su desarrollo cognitivo a través de su educación integral. Para lograr esto, se mostrará la elaboración de material de apoyo; este material se centra en el estudiante, en las teorías del aprendizaje y en un conjunto de acciones y procedimientos didácticos que utilizan la tecnología, lo que producirá un diseño de aprendizaje estratégico. La herramienta tecnológica introducida en el plan de educación del alumno sirve como un medio para visualizar conceptos, exploraciones y autoevaluaciones como parte fundamental en el desarrollo del modelo metodológico.

[1]BSc. In Licensed in Mathematics, Universidad Distrital Francisco José de Caldas, Colombia. PhD (c). in Mathematics Education, Universidad Antonio Nariño, Colombia. Current position: Professor Universidad Distrital Francisco José de Caldas, Colombia. E-mail: ogarcia68@gmail.com.

[2]BSc. In Licensed in Mathematics, Universidad Distrital Francisco José de Caldas, Colombia. MSc. In Mathematics applied, Universidad EAFIT, Colombia. Current position: Professor Universidad Distrital Francisco José de Caldas, Colombia E-mail: hvacca@gmail.com.

[3]BSc. In Licensed in Mathematics, Universidad Antonio Nariño, Colombia. Current Position: Profesor Universidad Antonio Nariño, Colombia. E-mail: hbuitargo@unarino.edu.co.

Citar este artículo como: O. Garcia, H. Vacca, H. Buitrago. "Technology applications to calculus". Visión Electrónica, algo más que un estado sólido, Vol. 11, No. 2, 306-310, july-december 2017. https://doi.org/10.14483/22484728.12924

1. Introduction

This research results, based on the inform [1], aims at answering these questions:

Which are the content criteria, methodology and evaluation that laboratory workshops guides must have to use them in the classroom by the teachers that teach mathematics, so that they impact as a teaching- learning strategy by which two or more subjects interact to construct learning, through discussion, reflection and decision making, that allows reaching the objectives designed by students and teachers?. What is the impact one must expect pedagogic practices will experience from the appropriation of those planned technologies through a methodology instrument used by teachers?. Which are the conditions so that teachers' technology appropriation is produced and that workshop and laboratories designers' expectations are translated in actions and results?

To answer these questions, a supportive material called lab workshop was elaborated and evaluated. This material was based on technology as a formative evaluation and methodology strategy for the development and learning of mathematics based on quality standards.

The present classroom project was directed to first semester engineering students from Universidad Distrital Francisco José de Caldas.

Through the use of computer technology "it is intended to develop other methodology alternatives as didactics elements that involve in a more active manner aspects such as a better knowledge understanding and evaluation" [1] given that learning autonomy and control is addressed. "The use of information, technology and computation (ITC) also allows the students to participate in determining the objectives for each class theme" [2]; that is, given the possibility of advancing autonomously to different rhythms, it is convenient that the student participates in determining in what direction and depth will she or he work the contents; it allows the student to consider his interests, and makes the contents go from an inevitable and fixed academic obligation to being connected with the real life of the person who tries to apprehend them. Only in this way, it is sure that a student, besides the meaning and understanding, can also construct senses that are always idiosyncratic, rooted in the way of thinking and feeling of each person.

"The evaluation of the support material is an indispensable tool to determine the importance and efficacy of this material as learning support, its cognitive impact and the construction of a collaborative environment where the development of individual and group abilities through teacher – student interactions in the exploration of new concepts is searched for" [3].

A pedagogic model was designed as a methodology resource in the classroom through problem solving, based on the objectives and curricular standards of the course, supported by the computer as a technology tool, Maple V package and Internet.

2. Methodology

The learning model methodology is designed as a result of the education convergence plan and the pedagogic model, in which its graphic structure and the relation among its components are specified.

The methodology model is structured to 2 components, the education plan and the pedagogic model. In Figure 1 below, we can see the relation between the design phase and the pedagogic model components that in the first place, are the ones that will guide the training process, where, if taken into the practice, the teacher will have a clear guidance (didactics strategy) for the conduction of the course. The dotted line represents the adjustments or changes in the design of training actions after student evaluation in order to optimize the didactics strategy and reaching the training objectives (in the case that they do not reach them with the designed training actions).

The tasks for which the teaching-learning design will be used are described as follows. "Emphasis is made on the relationship between mathematics and experience to carry out phenomena modelization that composes social, natural and mathematic characteristics" [4].

A crucial goal of this design is based on the relations that intend to develop abilities, reasoning and strategies to identify the mathematical model that corresponds to the phenomenon or problem and to interpret it within those representation systems to translate the solution, verify it and interpret it.

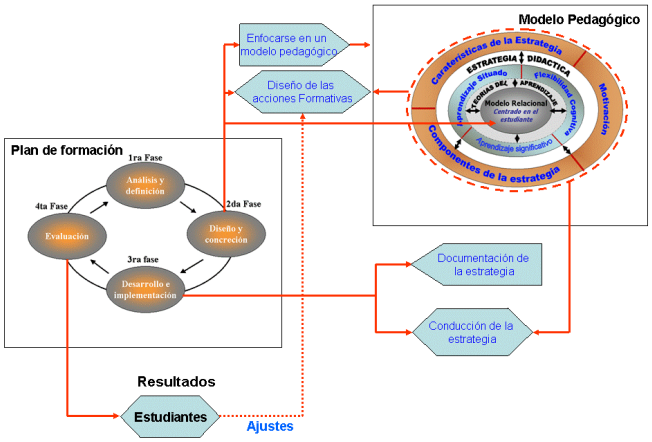
"Our physical environment is filled with phenomena that people try to study; they generate problem situations on them" [5]. The problem must be described in words by using a mathematic conceptual structure. The analysis, the interpretation and solution of these problems are sent to the students to solve with the necessary means.

Table 1: Results.

Item	5	4	3	2	1
I. Workshop guide evaluation					
1. The guide was clear	40 %	40 %	10 %	10 %	0 %
2. The guide objectives were understood	30 %	60 %	10 %	0 %	0 %
3. Each activity was understood	20 %	50 %	30 %	0 %	0 %
4. All guide activities were developed completely	35 %	40 %	20 %	5 %	0 %
Average	31 %	48 %	18 %	4 %	0 %
II. Workshop development					
1. Received teacher support during the development	70 %	15 %	15 %	0 %	0 %
2. Grade group work in the lab	40 %	45 %	15 %	0 %	0 %
3. Grade your individual work	35 %	45 %	20 %	0 %	0 %
4. Problems presented in the guide were clear	45 %	25 %	45 %	5 %	0 %
5. To write the report you received help from other teachers or tutors	15 %	25 %	15 %	30 %	15 %
6. Used reference books to write the report	25 %	35 %	20 %	10 %	10 %
7. After the workshop, needs a even bigger reinforcement on the theme	15 %	45 %	40 %	0 %	0 %
Average	35 %	34 %	24 %	6 %	4 %
III. Computer use					
1. Showed difficulties in the use of Maple	10 %	35 %	40 %	0 %	15 %
2. Used computer for the required activities	45 %	30 %	25 %	0 %	0 %
3. Guided problems help in the understanding of the theme	50 %	35 %	15 %	0 %	0 %
4. Interactive problems helped in the understanding of the theme	40 %	40 %	20 %	0 %	0 %
5. Believes that internet consultation helped better understanding of the theme	35 %	40 %	25 %	0 %	0 %
6. Grade the use of technology tools for the understanding of the theme	40 %	45 %	15 %	0 %	0 %
7. It is helpful to solve problems with the help of the computer	35 %	40 %	25 %	0 %	0 %
Average	36 %	38 %	24 %	0 %	2 %
IV. Generalities on the practice					
1. Workshop helped for the final test	20 %	50 %	25 %	5 %	0 %
2. Lab-workshop allows to better the final test	35 %	30 %	30 %	5 %	0 %
3. Complemented the studies with books for the final test	10 %	60 %	30 %	0 %	0 %
4. Grade how you felt about the understanding of the theme before the workshop	5 %	25 %	40 %	20 %	10 %
5. Grade how you felt about the understanding of the theme after the workshop	40 %	45 %	15 %	0 %	0 %
6. Grade lab workshop help the for the understanding of the theme	30 %	45 %	20 %	5 %	0 %
Average	23 %	43 %	27 %	6 %	2 %

Source: Own.

Figure 1: Pedagogic model and education plan relation.



Source: Own.

3. Results

When the average scores for every item are analyzed, it can be deduced that students value this strategy as Table 1:

Excellent 32 %; good, 40 %; acceptable 23 %; poor, 6 %.

In general terms, 72 % of students value the strategy as positive.

The assessment of each workshop in terms of technology used is quantified over 4, according to the scales of the defined criteria in the evaluation sections of each didactics analysis; they are presented in the following way, Table 2:

Table 2: Assessment of each workshop in terms of technology used.

	Workshop 1	Workshop 2	Workshop 3	Workshop 4
Group 1	3,2	3,3	3,3	3,4
Group 2	2,9	2,7	3,1	3,3
Average	3,1	2,5	3,2	3,3
Percentage	77,5	62,5	80	82,5

Source: Own.

As it can be observed, the average in technology management is within 75, 6 % of expected.

4. Conclusions

1. It was shown that the learning methodology model integrates, in a coherent way, important components such as: a training plan and a pedagogic plan that, based on this experience, favored learning inside and outside the classroom. Besides, after the experience, results and talks on this theme, the possibility of implementing or projecting this model to other areas of knowledge is open.

2. The training plan is crucial in the strategy design process, it allows to control all activities, and to develop clearly and objectively the learning design process steps. On the one hand, the training plan was enriched as the research was being developed in each phase, particularly in the design and implementation phase as well as in the evaluation phase. In the design and implementation phase, the methodology strategy bettered. The most adequate way to build the lab workshop was found, as well as the didactics activities and their evaluation.

   On the other hand, a control mechanism was proposed in the evaluation phase for the fulfillment of the training objectives and, thus, the objectives reach were evaluated.

3. The pedagogic model helped back learning directed to promote development of personal competences. Some of the most important personal competences that are, in fact, developed with the model are:

   - Communication, discussion and argumentation capabilities.
   - Knowledge of the environment that surrounds the student.
   - Development of the student critical sense: the capacity to understand situations, projects and solve the problems in authentic contexts.
   - Participation and compromise: capacity to promote learning among all participants, supported in the commitment each one assumes
   - Collaboration: Capacity to generate knowledge through the interaction among participants.
   - Intercultural sensitivity: Capacity to respect differences and the cultural diversity that participants present.
   - Information resources management.

4. The integration of the training plan and the pedagogic model strengthens the teaching- learning strategic design. "It is important to undertake a training program to organize the activities and, at the same time, to enable to carry them out based on an appropriate pedagogic model, the results of the integration of these components will be a methodological design directed to boost personal competences" [6].

5. The teacher establishes communication, orientation and help in the teaching-learning process that results beneficial for the student. Besides, the teacher must be an actor in the design of new strategic elements for feedback and redesign of lab workshops.

6. Formative assessment, developed in achievement indicators and the use of specific items, allowed an objective analysis of the students learning process and, besides, it was very useful in determining the mistakes or conceptual flaws. It is important to note that in general terms; the assessment designed here under curricular standards and components allows a complete conceptual revision of the performance and competences developed by the student.

7. The methodological strategy and the methodological method design made students acquire a better conceptual level when solving problems, but it is shown that it is not enough and does not completely solve the learning problem, since it is influenced by other hidden variables like the degree of motivation of the student, the responsibility with which they assume their own knowledge, the opportunity of individualizing their work with the computer, the time dedicated to the practices, etc.

8. The contribution to the area of research: the methodological model development, integrated with the methodological strategy based on problem solving supported by computer and the design of evaluations have been examined by experts who have indicated that this work contributes to mathematics education field.

References

[1] H. Buitrago, "Modelos metodológicos para la enseñanza de la matemática con resolución de problemas utilizando tecnología", Master in Mathematics education, Universidad Distrital Francisco José de Caldas, Bogotá, 2006.

[2] D. Macgrath, "The Bologna Declaration and Engineering Education in Europe", february 23 th 2017, [Online] Available: http://www.mie.uth.gr/labs/ltte/grk/quality/..%5Cquality%5Cbologna_declaration_engenee.pdf

[3] T. Escudero, "La evaluación como estímulo didáctico", Madrid: Publicaciones del MEC, 1999.

[4] A. Losada, "El currículo y las competencias, en Competencias Básicas aplicadas al aula", abc del educador Ediciones SEM. 2002, pp. 45-51.

[5] R. Davis, "Learning Mathematics. The cognitive Science Approach to Mathematics Education", Australia: Croom Helm. 1984.

[6] J. Cai, "Evaluation of Mathematics Education Programs", University of Delaware, USA: Elsevier Ltd, 2010.