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Technology of information and communication –tic

In teaching numerical methods*

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Abstract

This article analyzes the impact of Technologies of Information and Communication –TIC, on teaching numerical methods, to students of Systems Engineering, at Corporación Universitaria de la Costa –CUC. The main purpose is to identify how use of TIC affects this teaching process, and identify the technological tools used by the teachers. The methodology used is approached from a paradigm of mixed research, taking into account that aspects are examined from a quantitative vision, and because of the possibility of qualitative vision to impact education policies. Design of the research is not experimental, since it deals with students registered for the course of numerical methods. Within results obtained, it was established that the TIC improve teaching process of numerical methods to find roots. It was concluded that it is necessary to continue to research on other tools used in teaching numerical methods to find roots.

Key words: Internet, ICT, moodle, numerical methods.

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Introduction

At Corporacion Universitaria de la Costa, Barranquilla city, Colombia, there are six programs of Engineering, which the Department of Basic Sciences provides service; the various courses provided for these programs include Numerical Methods; this course is given in four semesters, and it is compulsory for programs of Systems Engineering, Civil Engineering, Electronic Engineering, and Elective for the other three Engineering Programs (Environmental, Electrical, and Industrial). Applicants to register for Numerical Methods should have taken and passed Numerical Programming, save Systems Engineering, which in previous semesters have taken the courses of Programming I, and II, as well as Algorithms I and II; in these courses the students have learned how to program, which is necessary for the course of Numerical Methods, used by Programming as a support in optimization of processes of the various methods, that a making the program, decrease the time for solution of the same.

Topics taught in Numerical Methods include methods for resolution of single variable equations, or to find roots; among these, five methods have been selected to perform the research. These are: Bisection, Newton –Raphson, Secant, False Rule and Muller. Some students find difficulty in handling these methods, therefore, some projects have been developed at Corporacion Universitaria de la Costa, through creation of software and web sites, which help to overcome this situation. But there has not been any study on the impact of these methods on teaching Numerical Methods, and specifically topics involving methods to find roots.

The research includes two objectives, as follows: General objective: To identify how the use of TIC impacts the process of teaching Numerical Methods to find roots in polynomial functions, in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC. Specific objectives: To identify the TIC used by teachers in teaching Numerical Methods to find roots in polynomial functions, in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC; and other objective is to describe how TIC are used in Numerical Methods to find roots in polynomial functions, in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC.

The question of research is: ¿How the use of TIC impacts the process of teaching Numerical Methods to find roots in polynomial functions, in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC.?

In order to achieve the objective, and answer to the question of research, this research was carried out at Corporacion Universitaria de la Costa, using students of fourth semester of Systems Engineering, both day and evening classes, having taken the course of Numerical Methods in the academic term 2011-01.

The work was carried out in various stages, which included: Bibliographic review and the state-of-the-arts, design and preparation of information collection tools. Realization of interview and surveys. Then, analysis of results obtained in the interviews, surveys, and observation; and finally, preparation of the final report, and discussion of results.

The TIC in education

Current students at the classroom are not the same used to be several years ago; students of today are immerse in handling technological tools which facilitate their teaching-learning process; they have cellular phones, graphic calculators, mini-portable, tablets, among others. The same happens to education institutions, which resources included just retro-projectors, TV sets, VH, the recorder; today such education institutions have available specialized classrooms to search for information a data bases specialized on various topics, digital boards, Internet, Wifi, video beam, and other available tools used to improve the process of teaching and learning.

As Schiavo (2007) states, the main use of TIC is using them as a tool that accelerates processes, and therefore decreasing time dedicated to such processes. Another important use is to organize the various activities and interact in the time-space created by technology, where distance does not exist, and time is continuous.

Teachers face the challenge of integrating the TIC into teaching – learning processes, derived from the need of globalization and such increasingly changing environment in which education institutions perform, (Martinez, 2011). Using TIC supposes for teachers using more sophisticated means than those habitually used (blackboards, books, paper, ball pens,

etc.), adding a very important function in teacher performance: the need of formation and updating methods. This need affects any teacher, but the TIC meets such need, and it becomes necessary to update teachers in the use of TIC, in order to efficiently use them as a tool in teaching, learning and evaluation.

Definitively the TIC, with their ample gamma hardware and software, turned into tools of the mind, used to empower it, facilitate creation of enriched learning environments, adapted to modern strategies of learning, with excellent results in developing cognitive skills of students in traditional areas of the curriculum (Eduteka, 2007).

The UNESCO (2008) in Standards of Competence on TIC for teachers, states, referring to the teacher role on the approach related to knowledge production, that teacher function consists of openly modeling learning processes, structuring situations in which students apply their cognitive skills, and assist student to acquire such skills. In-person classes performed at classrooms, in some cases lead to a series of activities which may not be fully performed at the classroom, resulting in the need for extra spaces where the students may complement and expand their knowledge through interaction with materials, other students, and the teacher, developing activities, either in individual or group basis, and using TIC .

Some resources considered as TIC may be used by teachers as a support in formation of students include (Arrieta, Florez, and Martinez, 2010):

- Video- conference
- Searchers
- Specialized software (text processors, spread sheets, data bases, graphic presentation programs, etc.
- Communication virtual spaces (forums, debates, …)
- E-mail
- Shared disks
- Chats and instantaneous messengers
- Multimedia didactic materials (on-line or local)
- Discussion/distribution lists
- E-board
- Hardware (printer, scanner, digital camera, etc.)

The computer has been the tool which leads to avail virtual means through Internet and the web, serving communication among individuals remotely located, at a fast speed, as an advantage to work with the TIC, increasing interaction level above space-time obstacles (Martinez, 2009). Internet and the web have not only been used to communicate, but they have become a tool of a great importance for transmission of knowledge, to show technological and scientific progress in the various areas of human knowledge; this is because we are immerse in the era of the society of knowledge, and the great importance achieved by the TIC in teaching-learning process.

In current teaching-learning process, it is important to take into account that such process has some important characteristics: the pedagogic model will have a didactic founded on the theory of multiple intelligence, a constructivist learning methodology, and creativity, by including major use of Internet and the TIC . (Nieto, 2009).

Teaching Numerical Methods through TIC

Numerical Methods prepare us to understand numerical schemes in order to resolve mathematic, engineering and scientific problems by using a computer, reduce numerical basic schemes, write programs, and resolved them in a computer, by correctly using available software, for such methods, and not only improves our skills to use computers, but also expands mathematic ability, and comprehension of scientific basic principles (Nakamura, 1992). Burden (2001), shows how Numerical Methods produce approaches sufficiently exact with a minimum effort.

Numerical Methods, may not ignore tools provided by technology, therefore, it is necessary to, each day, incorporate new techniques or tools, aimed at improving teaching learning process.

In the case of Numerical Methods, Chapra and Canales (2007), in its book of Numerical Methods applied to Engineering, shows how previously to the computer

appearance and its use in numerical methods, most energy used to be spent in the resolution technique, rather than definition and interpretation of the problem.

Currently, besides use of programming language, in class of Numerical Methods it is necessary to use other computer tools, such as mathematic software, or Excel, which may be used to perform some calculations. Using videos on various methods, leads the students to observe the calculations that should be used in resolving any problem, consultations to be made through participation in forums, chat or video-conferences.

Using web sites containing topics related to Numerical Methods also provide a great support, since they do not take into account the time or space, thus the student may access them, with no need for the teacher to be present, and no matter the place; the most important thing is to access the networks: Internet (Granados, 2009).

Materials and methods

In performing the research, the paradigm of mixed investigation was used, which, as claimed by Castro & Godino (2011) in his article titled Mixed Methods of Investigation in contributions to symposiums of the Seiem), "These methodologies allow to understand education activities within the context they happen, and at the same time contribute generalizable recommendations which support decision making in education policy" (p.99). Because of being mixed, qualitative and quantitative methods were used, as well as bibliographic consultation, surveys to students and teachers, and interviews to teachers.

The research was no experimental, since deliberated manipulation of variables was not realized; a specific group of students registered in the course of Numerical Methods was used, and in turn, it was descriptive, since it included a description of fundamental characteristics of the TIC used in teaching numerical methods to find roots.

In development of the research, surveys were administered using students of the program of Systems Engineering, taking Numerical Methods in current academic term 2011-01 at Corporacion Universitaria de la Costa-CUC. This course corresponds to the fourth semester of the program, and the students age is between 17 and 20 years, between women and men, coming from neighboring departments to Atlantico, municipalities of this department, and from Barranquilla city. Two teachers of the course of Numerical Methods were also used in the research.

Taking into account the type of project, in determining the size of the sample, the following statistical formula is used:

$n=N/(1+e^2*N)$

Where:

n= Represents the sample size on which the survey was realized

N= Represents target population

E= Represents the error percentage

For this Project, N is given by 52 individuals including 50 students and 2 teachers, the error (e) in this calculation is estimated in 9%, therefore, the sample size is the following:

$n = 50/(1 + ((0.09)^2 * 50) = 50/(1.405) = 35.587$

n =36 students of the program Systems Engineering to be surveyed.

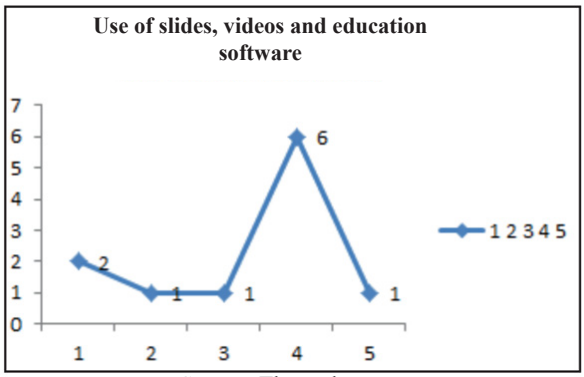
After surveying the students and the teachers, and having interviewed the teachers, and observations made, the information was tabulated to perform an analysis, using Excel to design tables and graphics.

Then the results were analyzed, and conclusions were drawn.

Results

Regarding some of the questions asked to the students, the following answers were obtained:

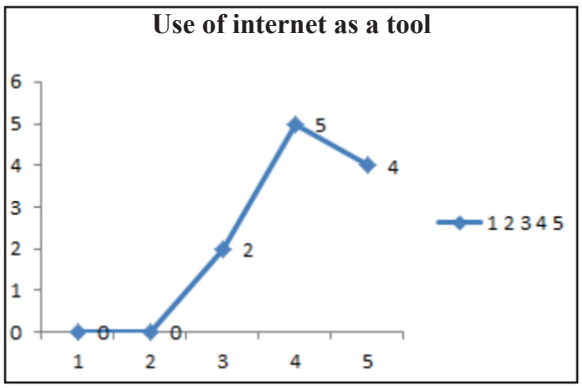
Graph 1



Source: The authors

More than 65% of the students consider that using slides or presentations on PowerPoint, videos or education software improves cognitive maturity of the student.

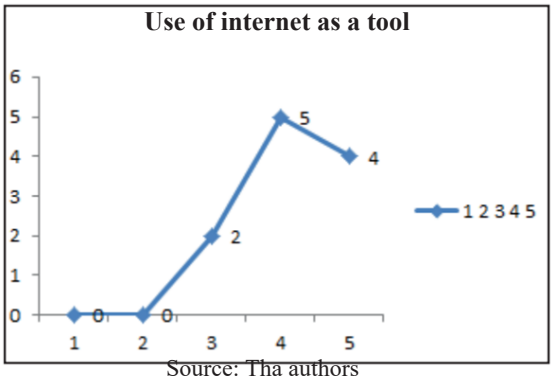
Graph 2



Source: Tha authors

All students consider that use of Internet as a pedagogic tool strengths meaning language of contents.

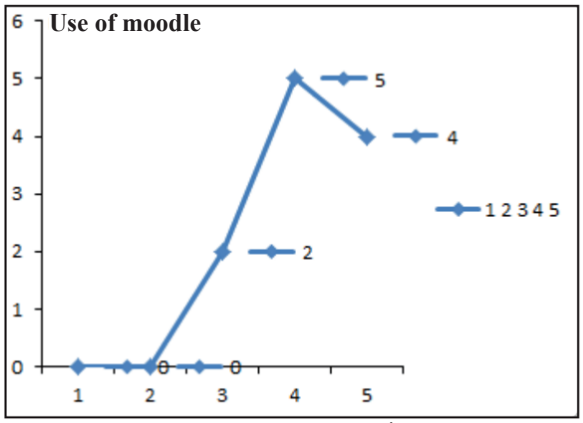
Graph 3



Source: Tha authors

In spite of the fact that most students feel satisfied of Access to use the TIC, it is worth to mention that, some of them expressed frustration because of non-availability of rooms at certain times, but other students stated that with Wifi Access it was not necessary to remain at the rooms.

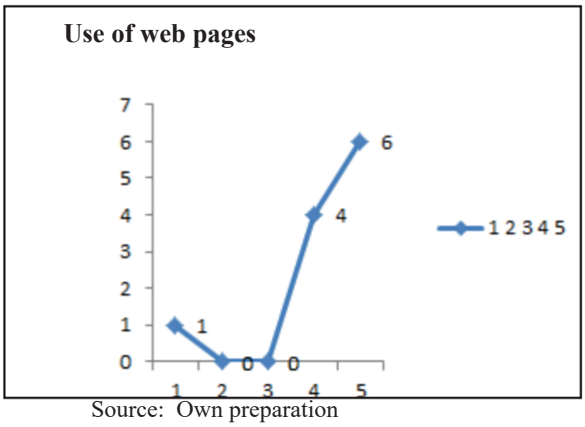
Graph 4



Source: Own preparation

All students consider that Moodle helps to improve comprehension of numerical methods, serves the teacher to hang in it, material of topics discussed, and indicate independent works to be performed by the students.

Graph 5



Source: Own preparation

All students consider that the web page helps to improve comprehension of numerical methods, students may find programs, algorithms, and explanation of methods.

Discussion and results

From an analogy between instruments used and answers obtained, we have table 1. Table 2 shows the result of some questions related to the TIC in surveys performed.

Table 1. Relationship between answers by teachers and answers by students

	STUDENT ANSWER	TEACHER ANSWER	CONCLUSION
The TIC	Questions (1, 6, 7) Teachers use the computer, Web sites, Moodle, teacher blog, graphic programs such as WinPlot, programming languages among other, since use of TIC facilitates the student autonomous work, a great part of learning success in learning Numerical Methods, depend on integration of student-owned factors and teaching contexts.	Questions (7,11,12,13,14,18,19) The students recognize diversity of use of tools used by the teacher, among them the TIC (videos, slides, Internet, MOODLE, web sites), which lead students to achieve a better learning.	Both, teachers and students consider that diversity of resources used, specially TIC, facilitates learning Numerical Methods by the students.
Numerical methods	Questions (2,3,4,5) The content of the program developed in the course is pertinent, when asked on the students performance regarding language used, they consider it between basic and good, and observed thought is the one of synthesis and deductive; however, when evaluated he answers showing little argumentation and preparation of the given topic for a teacher, but for another teacher, the	Questions (5,6,10,17) Explanations given by teachers, are good, but notwithstanding, some students do not find applicability of topics covered, and that teachers evaluate them the whole process performed, by the student to achieve learning.	The content is in agreement with what should be taught in the course, but the students claim that more examples of application of topics covered are necessary.
Tools availability	Question (8) The teachers agree that in spite of the fact that the university has several tools which lead to use the TIC , there are serious problems related to updating many computer pieces, both, for equipment used by teacher, and students.	Questions (8,9,15,16) Coaching offered by teachers is not used by the students, computer rooms sometimes are not available, although they do have the necessary tools.	Although these tools are considered as insufficient, and that more are needed for the student to properly Access such tools.
Sudent commitment	Question (5) For a teacher, when evaluating students during the class, they answer showing little argumentation and preparation of the given topic. On the other hand, for another teacher, the students show proper performance.	Questions (1,2,3,4) Little time is dedicated to analysis, and realization of exercises and activities; for others, difficulty is related to interpretation and comprehension of stated situations, little interest dedicated to independent work by the student of the	Some negative results are due to scarce time dedicated to independent labor, specially those employed students

Source: Own preparation

Table 2. Results of some questions related to the TIC of the survey

	Question in the survey	Answer percentage				
		1	2	3	4	5
1.	¿Do you consider that by using the TIC in classes of Numerical Methods, you would develop scientific competences, and a better learning?	0	27	9	27	37
2.	¿Does using slides, videos and education software increase cognitive maturity in learning Numerical Methods?	18	9	9	55	9
3.	¿Is significant learning of contents and attitude toward strategies of significant learning in teaching Numerical Methods strengthened when using Internet at the classroom as a pedagogic tool?	0	0	18	46	36
4.	¿Do you consider that using the Moodle helps better comprehension of Numerical Methods to find roots?	0	0	18	46	36
5.	¿Do you consider that using the Web page helps better comprehension of Numerical Methods to find roots?	9	0	0	36	55

Source: own preparation

In application of the survey, the answers given in items corresponding the use of TIC, the following was established:

- Acceptation by the students of resources such as: The web site of numerical methods, Moodle, and other tools, and topics covered in the course.
- Dominion by the teacher of the various tools used in the course.
- In accessing technological resources at the university, the students face some difficulty related to availability of computer devices, but using WIFI they may access using their own equipment.
- Availability of materials and access to information at the desired place and time, by using Internet.

It was found that TIC used by teachers in teaching numerical methods to find roots un polynomial functions, to students of Systems Engineering at the CUC, are the following: Internet, web sites, blogs, specialized data bases, and the Moddle, as tools where the students may perform independent work, and mail it to the teacher; thus facilitating the teacher control of teaching process.

The various tools are used to teachers to teach the various methods, for students to achieve significant learning parting from previous skills. The students prepare programs, run software already created to check their results, sue internet videos, to clarify questions, mail and consult information through the Moodle.

Everything cause the TIC to impact the teaching process of numerical methods to find roots in polynomial functions in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC.

Conclusions

It may be stated that the TIM improve the process of teaching numerical methods to find roots in polynomial functions in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC, since, taking into account what they expressed in the surveys and observations on the TIC, they declared that this tool would be of a great help in their learning process, and in strengthening what they learned.

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Everything cause the TIC to impact the teaching process of numerical methods to find roots in polynomial functions in formation of students of Systems Engineering at Corporacion Universitaria de la Costa –CUC.

It is suggested to explore using other tools such as video-conferences, in order to take advantage of agreements held by the university institution with foreign universities, and realize conferences or discussion with teachers of courses from other countries, running information where Numerical Methods are used, for the student to observe their applicability, and learn about the sense of this course. Also, realization of forums and chat, which are not being performed, and is not reported by teachers and students, bearing in mind that such means would facilitate the students to perform synchronic or non-synchronic consultations either to the teacher or their peers.

The course of Numerical Methods include other topics which may be used in preparing future research, such as: methods to resolve differential equations; methods to realize polynomial approximations; methods to resolve integrals, among other, each one using several methods. Research could be carried out on importance of TIC in teaching-learning process of any of these topics, or on didactic strategies used in teaching methods to resolve differential equations, or integrals.

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