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Evaluación del método de enseñanza-aprendizaje contenido con apoyo de las tecnologías de la información y comunicación (MEAC-TIC) para mejorar la resolución de problemas algorítmicos

Evaluation of the method of teaching - learning content with support of information technologies and communication (MEAC-ICT) to improve the resolution of algorithmic problems

Avaliação do método de ensino-aprendizagem contido com o apoio de tecnologias de informação e comunicação (MEAC-TIC) para melhorar a resolução de problemas algorítmicos

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Resumen

En este trabajo se presentan los resultados conseguidos con el método de enseñanza-aprendizaje contenido (MEAC), apoyado en las TIC, que se implementó con 20 estudiantes de primer grado de la Escuela Secundaria Técnica Industrial n.°15 de Tierra Blanca (Veracruz) para promover la resolución de problemas algorítmicos en la materia Informática. En tal sentido, se realizó una investigación de tipo cuantitativo, con un diseño experimental de preprueba y posprueba en dos grupos: uno experimental y otro control. Para la representación de los datos se empeló el *software*

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

estadístico Minitab 16, el cual sirvió para realizar la prueba estadística *T* de dos muestras para mostrar el nivel de significancia entre los grupos seleccionados. Los resultados indican que existe una diferencia significativa entre ambos grupos, por lo que se puede afirmar que el método MEAC-TIC mejora la resolución de problemas algorítmicos.

Palabras clave: algoritmos, aprendizaje contenido, enseñanza contenida, método MEAC-TIC.

Abstract

This paper presents the results obtained with the content-teaching-learning method (MEAC), supported by ICT, which was implemented with 20 first-graders from the Industrial Technical Secondary School No. 15 in Tierra Blanca (Veracruz) to promote the resolution of algorithmic problems in the field of Information Technology. In this sense, a quantitative research was carried out, with an experimental pre-test and post-test design in two groups: one experimental and one control. For the representation of the data, the statistical software Minitab 16 was used, which was used to perform the statistical test T of two samples to show the level of significance among the selected groups. The results indicate that there is a significant difference between both groups, so it can be said that the MEAC-TIC method improves the resolution of algorithmic problems.

Keywords: algorithms, learning content, contained teaching, method MEAC-TIC.

Resumo

Este artigo apresenta os resultados obtidos com o método de ensino-aprendizagem de conteúdo (MEAC), apoiado pelas TIC, implementado com 20 alunos da 1ª série da Escola Técnica de Ensino Médio Industrial nº 15, em Tierra Blanca (Veracruz). promover a resolução de problemas algorítmicos no campo da Tecnologia da Informação. Neste sentido, foi realizada uma pesquisa quantitativa, com delineamento experimental pré e pós-teste em dois grupos: um experimental e um controle. Para a representação dos dados, foi utilizado o software estatístico Minitab 16, que foi utilizado para realizar o teste estatístico T de duas amostras para mostrar o nível de

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

significância entre os grupos selecionados. Os resultados indicam que há uma diferença significativa entre os dois grupos, portanto, pode-se dizer que o método MEAC-TIC melhora a resolução de problemas algorítmicos.

Palavras-chave: algoritmos, aprendizagem de conteúdo, ensino de conteúdo, método MEAC-TIC.

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Introduction

Currently, the new information and communication technologies have revolutionized not only the way of life, but also the way in which the teaching and learning processes are developed, which has generated a series of diverse transformations in the pedagogical paradigms that they guide the educational practices of all disciplines (Kuhn, 2012). In the field of mathematics, for example, mental calculation was used for a long time (that is, without the help of pencil and paper) to solve numerical problems of any kind (Mochón and Vázquez, 1995). However, with the passing of time, other methods were implemented, such as the one proposed by the scientist and mathematician George Pólya - which was called the Pólya method (Salinas and Sgreccia, 2017) -, which was designed to solve algorithms by applying four methods. essential steps: understand the problem, design a plan, execute the plan and examine the solution.

Another was the one created by professor Jaime García Montero, called open method based on numbers (ABN), which was very popular in learning mathematics in early childhood and primary education, because it sought to give all the freedom to students to perform in different ways the operations of problems. In this way an attempt was made to promote the research capacity and motivation of the student to reach an optimal solution of the assigned problem (García, 2016).

Similarly, other more recent ones have been proposed, such as the one that is based on learning objects - understood as a digital information entity developed to generate knowledge, skills and attitudes (Rodríguez, Medina, González and López, 2017) - or the content-teaching-learning method (MEAC-TIC), which does not replace the steps of the Pólya method or the

learning objects, but relies on the use of ICT and the learning styles of Bandler and Grinder (visual , auditory and kinesthetic) to try to concentrate the student's attention on solving problems (Mera and Amores, 2017). This in a context where today's student, as pointed out by Salazar (2008), can feel apathy for the contents related to mathematics or can be easily distracted due to the multiple visual and auditory stimuli of an increasingly digitalized world (López, Llorent y Medina, 2017).

Method

General objectives

- Evaluate the impact on the teaching and learning of algorithms using the MEAC-TIC method with first-grade students of the Computer Science subject at Industrial Technical Secondary School No. 15 in Tierra Blanca, Veracruz.

Specific objectives

- Apply the instrument of data collection in the pre-test and post-test stages to the 20 students of the control group and 20 students of the experimental group.
- Quantitatively assess how the application of the MEAC-TIC method influences the teaching and learning of solving algorithmic problems in the 20 young people of the experimental group.

Type of study

- The present study is of a quantitative nature and has a correlational scope, since it visualizes the quantification and association of the variables used.

Hypothesis

A correlational hypothesis is used.

Hi: The use of the MEAC-TIC method increases the resolution of algorithmic problems.

Hn: The use of the MEAC-TIC method does not increase the resolution of algorithmic problems.

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Ha: The use of the MEAC-TIC method increases the speed of design in the resolution of algorithmic problems.

Tabla 1. Cuadro de variables

Método MEAC-TIC **Variable independiente**	**Resolución de problemas algorítmicos** **Variable dependiente**
Definición conceptual Es el método de enseñanza-aprendizaje contenido, el cual busca encapsular la transmisión de conocimientos apartando los factores que distraen el proceso enseñanza y aprendizaje con apoyo de las tecnologías de información y comunicación.	Definición conceptual Calificación obtenida por la solución de un problema algorítmico en donde mediante una rúbrica se evalúan aspectos como sintaxis, contenido, coherencia, variables, resultado, etc.
Definición operacional Utilización del método MEAC-TIC.	Definición operacional Calificación de la rúbrica de resolución de problemas algorítmicos

Fuente: Elaboración propia

Research design

An experimental research design has been used, specifically of "pure experiments", since the independent variable is manipulated using an experimental and a control group.

Control and internal validity

At the end of the study, a comparison was made between the two groups of this research, that is, a control group that has no affectations and an experimental group that is given the treatment with the independent variable using the MEAC-TIC method.

Reci
Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Initial equivalence

The method of pairing or matching technique was used in order to equalize the groups in terms of the criterion of total grade of the primary. To do this, the two groups were matched with the same number of young people in terms of ratings in the range of 10-9, 8-7 and 6.

Design with pretest-post test and control group

In principle, the two groups of this research were pre-tested without manipulating the independent variable; later, only the experimental group was treated with the MEAC-TIC method (Petrosko, 2004, cited by Hernández, Fernández and Baptista, 2014).

Sample

The population chosen for this study was constituted by 40 first-grade students who were studying Computer Science. The sample was probabilistic, although it was taken to the total population due to the number of individuals, which were divided into two groups using the pairing method to create the control group and the experimental group.

Measuring instrument

A discussion of algorithmic problems has been used, consisting of an instrument and procedure specific to the aforementioned discipline (Hernández *et al.*, 2014).

Results and Discussion

To graph the pre-test and post-test data, the Minitab 16 program was used, which was used to calculate a T with two samples to evaluate if there was a difference in the ratings of the experimental group (with which the MEAC-TIC methodology was used).) and the control group.

Pretest

For the pretest, a written test consisting of five algorithms with a basic pseudocode with a total value of 10 points was applied. The data were processed in the Minitab 16 program, using the T test of two samples: GCCalif1, GECal1 (figure 1).

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 1. Datos de la preprueba obtenidos con Minitab 16

Prueba T e IC de dos muestras: GCCalif1, GE Calif1

T de dos muestras para GCCalif1 vs. GECalif1

	N	Media	Desv.Est.	Error estándar de la media
GCCalif1	20	4.95	3.03	0.68
GECalif1	20	6.13	2.86	0.64

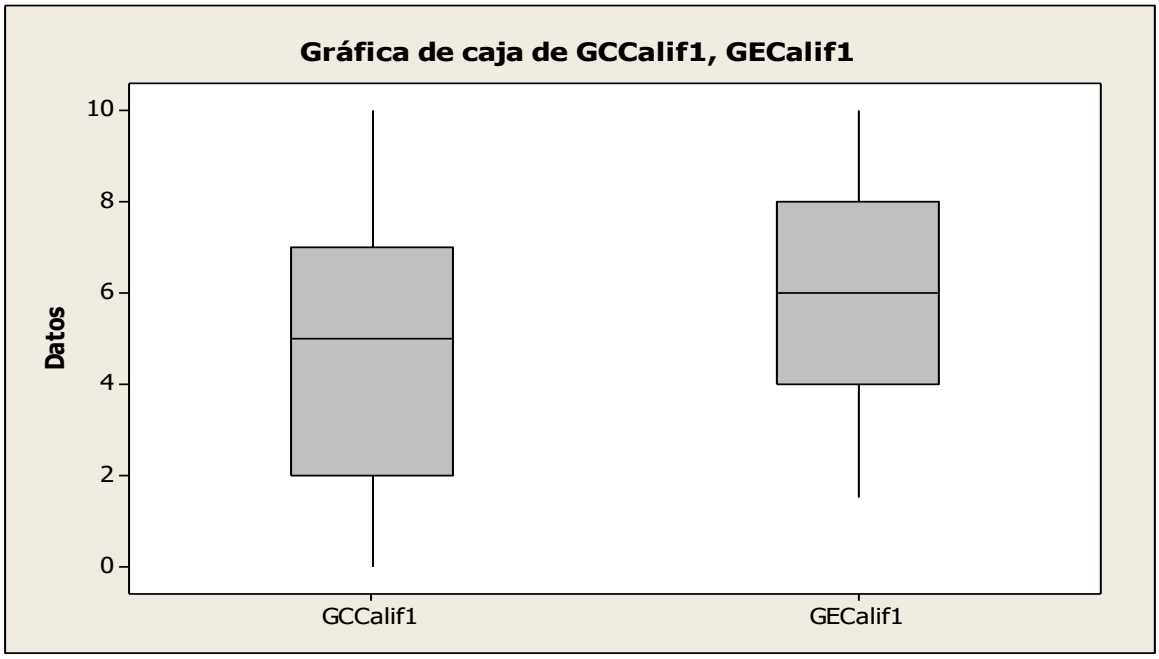
Diferencia = mu (GCCalif1) - mu (GECalif1)
Estimado de la diferencia: -1.175
IC de 95% para la diferencia: (-3.061, 0.711)
Prueba T de diferencia = 0 (vs. no =): Valor T = -1.26 Valor P = 0.215 GL = 37

Fuente: Elaboración propia

Figure 1 shows that the GECal1 experimental group had a higher score, since the mean was 6.13, while in the control group GCCalif1 it was 4.95. The value of p was 0.215, that is, greater than the level of significance of 0.05, which indicates that there is no significant difference in the scores of the control and experimental groups. Then, in figure 2 the ratings of the two groups are shown, where it can be seen that the experimental group achieved a slight increase.

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 2. Valores de la preprueba de calificaciones del grupo control y experimental obtenidos con Minitab 16



Fuente: Elaboración propia

Posttest 1

A written examination consisting of five basic algorithms with a total value of 10 points was applied. The data was reviewed in Minitab 16 using the T test of two samples: GCCalif2, GECal2 (figura 3).

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 3. Datos de la posprueba 1 obtenidos con Minitab 16

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T de dos muestras para GCCalif2 vs. GECal2

                                 Error
                               estándar
                                  de la
            N  Media  Desv.Est.  media
GCCalif2   20   2.29       2.02   0.45
GECal2     20   3.76       2.05   0.46


Diferencia = mu (GCCalif2) - mu (GECal2)
Estimado de la diferencia:  -1.470
IC de 95% para la diferencia:  (-2.773, -0.167)
Prueba T de diferencia = 0 (vs. no =): Valor T = -2.29  Valor P = 0.028  GL =
     37
```

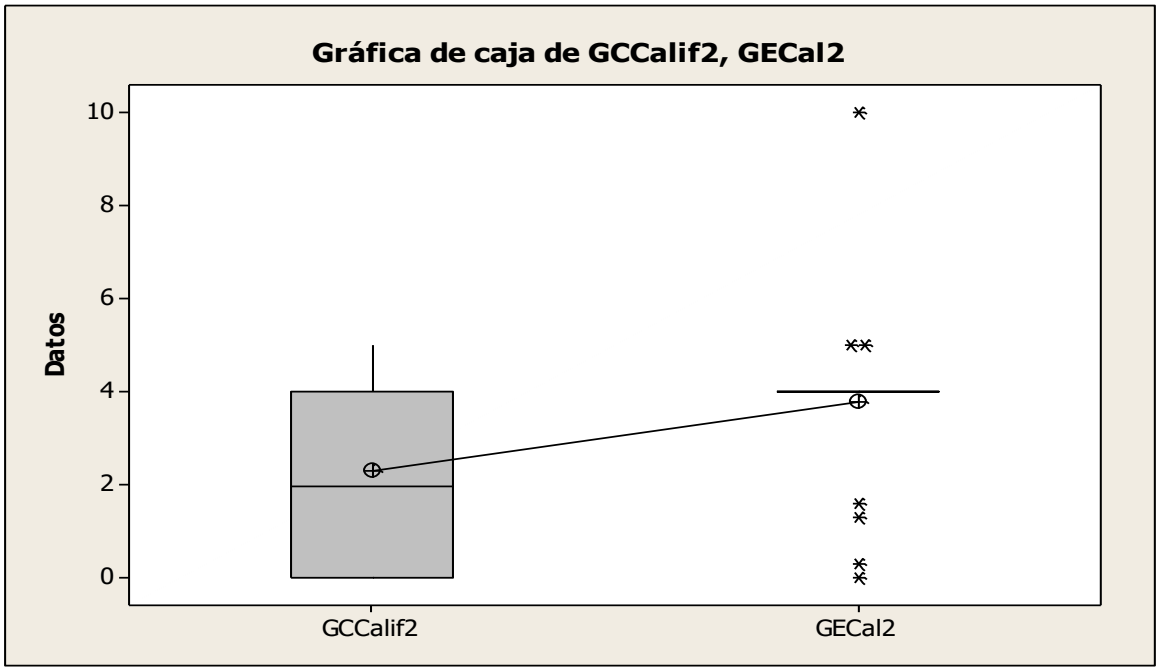
Fuente: Elaboración propia

Figure 3 shows that the experimental group GECal2 had a higher score, since the mean was 3.76, while in the control group GCCalif2 it was 2.29. The value of p was 0.028, lower than the level of significance of 0.05, which indicates that there is a significant difference in the scores of the control and experimental group. Therefore, it is concluded that the ratings of the experimental group are greater, with which the null hypothesis is rejected.

Next, Figure 4 shows the qualifications of the control and experimental group, where there is a considerable increase in the latter's ratings.

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 4. Valores de la primera muestra de calificaciones del grupo control y experimental obtenidos de Minitab 16



Fuente: Elaboración propia

Posttest 2

A written examination consisting of five algorithms using constants and variables with a total value of 10 points was applied. The data were processed in the Minitab 16 program using the T test of two samples: GCCalif3, GECal3 (figure 5).

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 5. Datos de la posprueba 2 obtenidos con MINITAB 16

Prueba T e IC de dos muestras: GCCal3, GE Cal3

T de dos muestras para GCCal3 vs. GECal3

	N	Media	Desv.Est.	Error estándar de la media
GCCal3	20	2.03	2.37	0.53
GECal3	20	4.80	2.49	0.56

Diferencia = mu (GCCal3) - mu (GECal3)
Estimado de la diferencia: -2.770
IC de 95% para la diferencia: (-4.327, -1.213)
Prueba T de diferencia = 0 (vs. no =): Valor T = -3.61 Valor P = 0.001 GL = 37

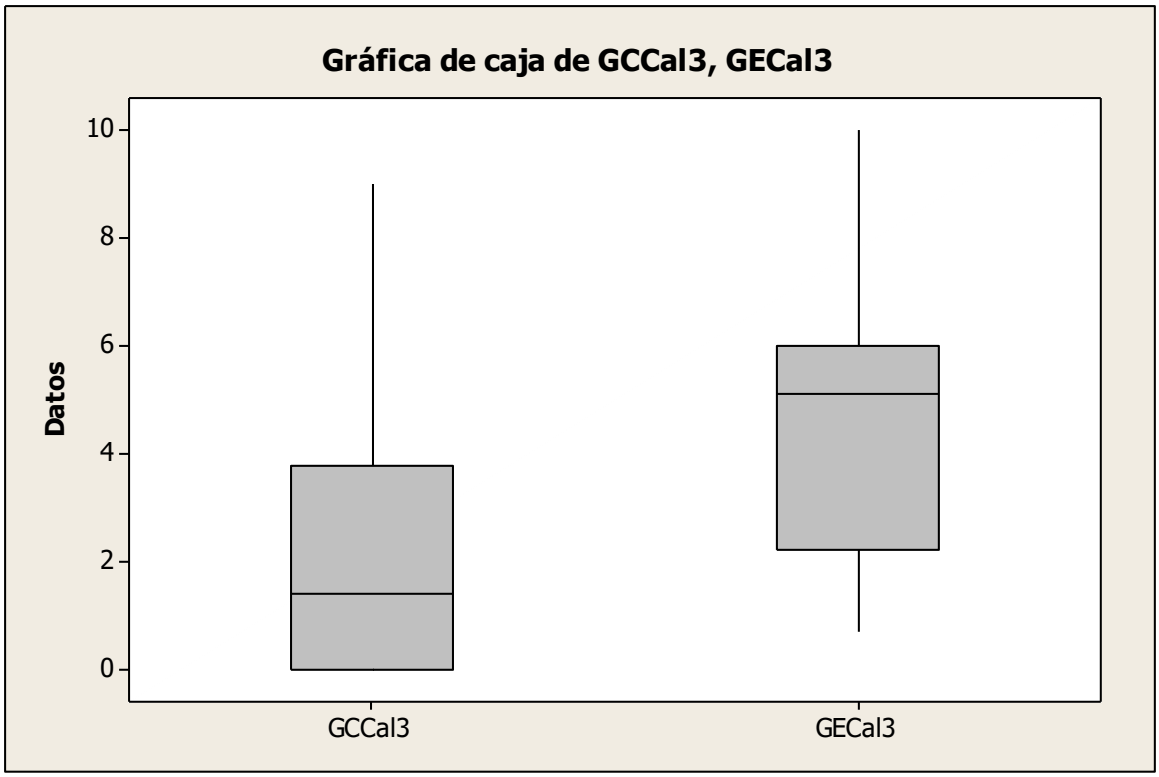
Fuente: Elaboración propia

Figure 5 shows that the GECal3 experimental group had a higher score, since the mean was 4.80, while the control group GCCalif3 was 2.03. The value of p was 0.001, that is, less than the significance level of 0.05. This shows that there is a significant difference in the scores of the control and experimental group, which indicates that the ratings of the experimental group are higher. With this the null hypothesis is rejected.

Next, figure 6 shows the qualifications of the control and experimental group in the second sampling, where a considerable increase in the ratings of the experimental group is observed.

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

Figura 6. Valores de la segunda muestra de calificaciones del grupo control y experimental obtenidos con el programa Minitab 16



Fuente: Elaboración propia

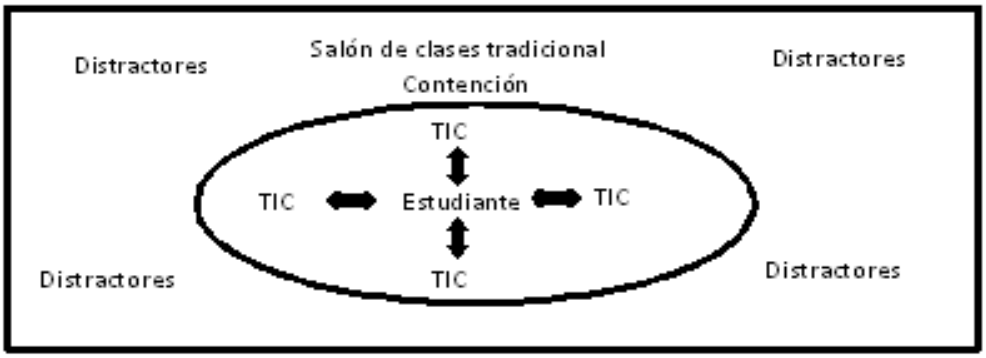
Once the results of the pretest have been obtained, it can be noted that in the algorithm test with pseudocode applied to the control group of 20 students, a mean grade of 4.95 was obtained, that is, a little below the mean of the control group, which was 6.13. Likewise, a small difference is visualized, as well as little correlation of p = 0.215, which was higher than the standard of significance of 0.05. This indicates that although the control group had less average scores than the experimental group, it does not present a level of significance.

In relation to post-test 1, where a written examination of basic algorithms was applied, a mean of 2.29 was obtained in the control group, that is, lower than the average of the experimental group of 3.76. The value of p was 0.028, lower than the level of significance of 0.05, which represents a significant difference in their ratings. Finally, in the post-test, the control group obtained a mean of 2.03, lower than the previous averages compared to that obtained from

the experimental group, which was 4.80. The p-score was 0.001, that is, lower than the significance level of 0.05. This shows that in post-test 2 there is a significant difference in the scores of both groups, specifically that of the experimental group, which was higher. With this the null hypothesis is rejected.

On the other hand, and as already mentioned, the MEAC-TIC method seeks to use ICT to promote student concentration in the activities developed in the classroom. To achieve this, in this research various technological components were used (cellular, hearing aids, wireless keyboard and an integrating support) to show a video whose duration was 1.30 minutes. In this, an algorithm resolution topic was explained in detail; later, the student interacted with a spreadsheet with the Documents to go software, version 4.0, to practice with a problem explained in the video; in this way, and without any distraction, we tried to promote meaningful learning. The development of this method is shown below (figure 7):

Figura 7. Método MEAC-TIC



Fuente: Elaboración propia

As is to be expected, the MEAC-TIC method requires work in conjunction with modern technological devices, which implies a technological mediation (Riascos, Quintero and Ávila, 2009) and, therefore, a change in the daily academic work to try achieve meaningful learning (Ausubel, cited by Toapanta, 2017). All those technological changes, together with the phenomenon of social imaginaries commented on by Cabrera (2006), explicitly require a transformation of current educational models (Barker, 1995).

Revista Iberoamericana de las Ciencias Computacionales e Informática
ISSN: 2007 - 9915

In this sense, not only must the teaching and learning process be conceived as a complex system (Morín, 1998), but also one must dare to implement new strategies within the classroom, such as the MEAC-TIC method, which attempts to present the friendly content through the use of technological devices with which students are familiar (Cabero, Fernández y Marín, 2017).

Conclusions

Presented the results of this work, it can be noted that there is a significant difference between the traditional method and the MEAC-TIC, because with the latter the students achieved better levels of learning, which is evidenced by the ability to assimilate more easily the problems basic algorithms. Regarding teachers, this strategy was very useful to present innovative content through the use of ICT. This research, finally, contributes to the development of future lines of research related to teaching methods, learning supported by ICT, objects of study, etc.

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Revista Iberoamericana de las Ciencias Computacionales e Informática
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