

## App 4LG3BR4 a tool for learning basic Algebra in students of Information and Communication Technologies

### App 4LG3BR4 una herramienta para el aprendizaje del Álgebra básica en alumnos de Tecnologías de la Información y Comunicación

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#### Abstract

Currently, technology has evolved and has been adopted in education, this is where another field opens up to analyze academic performance, now students do not interact with books or notebooks, they can do it with a Tablet, with a PC, a Smartphone or some other device that allows them to be interconnected; in this sense, the educational experience has different dimensions. Therefore, this research focused on the use of a mobile application for learning basic algebra, with the students of the Division of Information and Communication Technologies of the Technological University of La Selva. The study was carried out under a quasi-experimental quantitative approach, using tests designed with dichotomous answers (pre-test and post-test) as data collection tools. The results show that using the App 4LG3BR4 in the subject of Linear Algebra in the teaching and learning process, significantly increases the academic performance of students, compared to the traditional teaching of these subjects in the aforementioned subject.

#### Resumen

Actualmente la tecnología ha evolucionado y se ha adoptado en la educación, es aquí donde se abre otro campo para analizar el rendimiento académico, ahora los alumnos no interactúan con libros o cuadernos, lo pueden hacer con una Tablet, con una PC, un Smartphone o algún otro dispositivo que les permita estar interconectados; en este sentido, la experiencia educativa tiene diferentes dimensiones. Por lo anterior, esta investigación se centró en la utilización de una aplicación móvil para el aprendizaje del álgebra básica, con los estudiantes de la División de Tecnologías de la Información y Comunicación de la Universidad Tecnológica de la Selva. El estudio se efectuó bajo un enfoque cuantitativo cuasiexperimental, utilizando como herramientas de recolección de datos, pruebas diseñadas con respuestas dicotómicas (pre-test y pos-test). Los resultados demuestran que usar la App 4LG3BR4 en la materia de Álgebra Lineal en el proceso de enseñanza y aprendizaje, incrementa significativamente el rendimiento académico de los estudiantes, comparado con la enseñanza tradicional de éstos temas en la materia mencionada.

**Mathematics, Algebra, Application, Mobile**

**Matemáticas, Álgebra, Aplicación, Móvil**

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## Introduction

We are currently changing our way of facing everyday life and this is no exception for educational institutions, mainly in academic activities when applying the teaching and learning process.

After at least two years of confinement derived from COVID-19, educational institutions are facing the return of teachers and students to the spaces previously used for training activities (Linares-Morales, 2022), forcing the integration of Information and Communication Technologies (ICT) in teaching processes.

ICTs are immersed in practically all areas of human endeavor and, of course, in the educational area they cannot be absent. Portuguese (2021) mentions that technologies that are attractive to students and increase their interest in learning should be included. There are different technological tools that can be used to solve a problem and there are also different methods. Higher education seeks to implement ICT in the development of competencies (Herrera and Fennema, 2011), based on students' self-taught learning, using mobile devices as a support tool for learning inside and outside the classroom.

Mobile technologies, such as smartphones, tablets, and laptops, in addition to online applications and tools, became an integral part of most teachers' and students' lives worldwide (Drigas & Pappas, 2015). Kortabitarte, Gillate, Luna and Ibañez-Etxeberría (2018) states that, "the learner acquires a greater protagonist role, as mobile devices allow them to learn anytime, anywhere, self-regulate their learning" (p. 69). Araya (2007) mentions that, "the tasks proposed should awaken the student's interest. Those that present a certain degree of challenge are more attractive than those that are routine or easily solved" (p. 20).

Consequently, the development process of mobile applications for educational purposes should aim to respond to the needs of the educational environment and combine them as an intermediary in the teaching and learning process (Escobar-Reynel et al., 2021).

In recent years, mobile applications have been developed to support the teaching of various areas of mathematics, such as algebra, geometry, mathematical analysis, statistics, among others; these applications can help students improve their understanding of mathematical concepts and their problem-solving skills (Drigas and Pappas, 2015).

Kaloo and Mohan (2012), conducted an investigation to determine whether the MobileMath mobile application to learn algebra improved their academic performance, the data showed that it was significant for those who had already taken the subject of algebra in a previous period, but did not have a significant impact for those who were taking the subject for the first time.

Díaz (2017), conducted an investigation on the influence of algebra learning with the use of the GeoGebra application, the results show that the application influences algebra learning and recommends its use at all educational levels.

Arjona, Guerrero, Noh and Ay (2019), conducted a study to determine whether the mobile application developed supported the learning of the topic Algebraic Language, the application consisted of four didactic games, the results showed that 44.4% of the students found it difficult to learn with the application, it was accepted by the teachers of the mathematics area, however, they proposed observations for improvement.

## Statement of the problem

At the Universidad Tecnológica de la Selva, before the pandemic caused by COVID-19, students enrolled in the first four-month period of technological careers had a high failure rate in the subject of Linear Algebra (see Table 1), due to the fact that "the understanding of concepts of Algebra has been the Achilles' heel of the students [...], where they apply arithmetic knowledge to solve problems [...], and the knowledge they acquire in previous educational levels is not enough to solve algebraic expressions or equations" (Domínguez-Gutú et al., 2022, p. 2).

Year	Students who took the course	Failed students in regular classes	Failure rate
2018	77	10	13.0%
2019	71	39	54.9%
Totals	148	49	33.1%

**Table 1** Failure rate in the subject of Linear Algebra unit II

Source: (Domínguez-Gutú et al., 2022)

Consequently, the researchers made the decision to use the mobile application 4LG3BR4 developed by Domínguez-Gutú et al. (2022), as a support tool in the teaching and learning process of basic Algebra for incoming students in the three specialty areas of the Information Technology Division of the Universidad Tecnológica de la Selva.

## Objective

The present research study aims to analyze the impact on the academic performance of students who used the mobile application 4LG3BR4 in the subject of Linear Algebra.

## Methodology

According to Hernández, Fernández and Baptista (2014), this research was conducted under a quantitative approach, using a quasi-experimental design with an experimental group and a control group, with the independent variable being the use of the 4LG3BR4 App and the dependent variable being academic performance, for which the hypothesis "The use of the App 4LG3BR4 significantly improves the academic performance of first semester students of the technology careers of the Universidad Tecnológica de la Selva de Ocosingo, Chiapas, in the subject of Linear Algebra in the topics of basic Algebra" was proposed.

## Sample

The sample of this study was non-probabilistic and intentional, and intentional, considering 101 students, 60 of them in the experimental group, of which 46 were males and 14 females; 41 in the control group, 30 males and 11 females.

## Instrument

For data collection, a pre-test and post-test designed for the study were used, with dichotomous answers, in order to measure the academic performance of the students; the results obtained by the students in the tests were converted into scores with a scale from 0 to 10, in order to perform a statistical test for the difference of means.

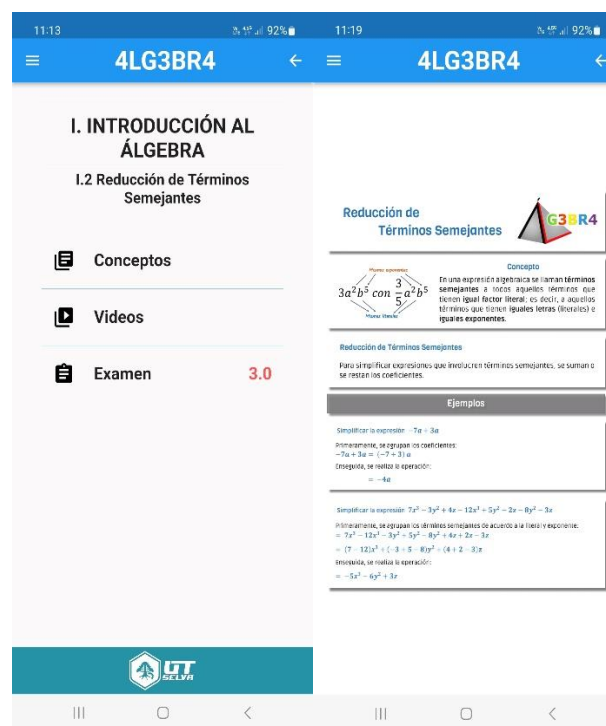
To calculate the reliability of the dichotomous instrument, the Kuder-Richardson coefficient (KR20) was used with the statistical software RStudio Version 2022.07.01, yielding a value of 0.7 located in the High magnitude range (Ruíz, 2013), making it an instrument with an Acceptable reliability coefficient.

## Development

The intervention carried out in the experimental group was designed with a didactic sequence, implemented through the following phases:

### Initial phase.

The researchers designed the intervention using the mobile application 4LG3BR4, which was developed according to the thematic content of the Linear Algebra course taught in the 1st quarter of the ICT Division of the Universidad Tecnológica de la Selva.



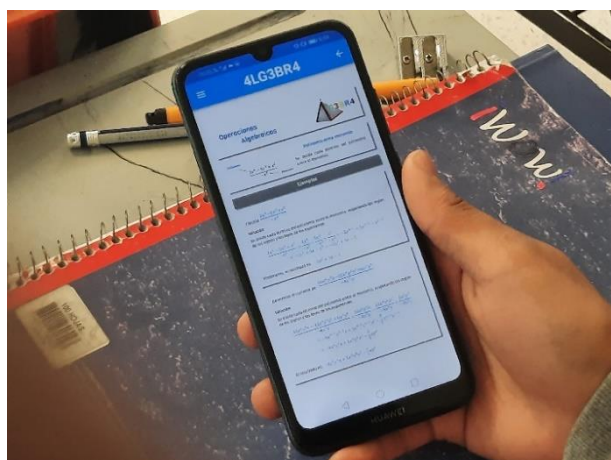
**Figure 1** Part of the content of the 4LG3BR4 App  
Source: Images from the research

## Intervention phase

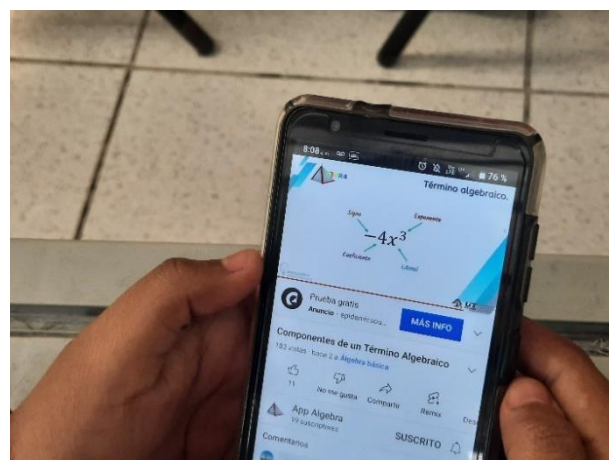
Before carrying out the intervention, the pre-test was applied in both groups, in order to measure the previous knowledge they had in each of the basic Algebra topics; subsequently, in the control group, the teacher proceeded to develop the topics in the traditional way, in the experimental group the intervention designed for the study was carried out, where the students used the mobile application 4LG3BR4.



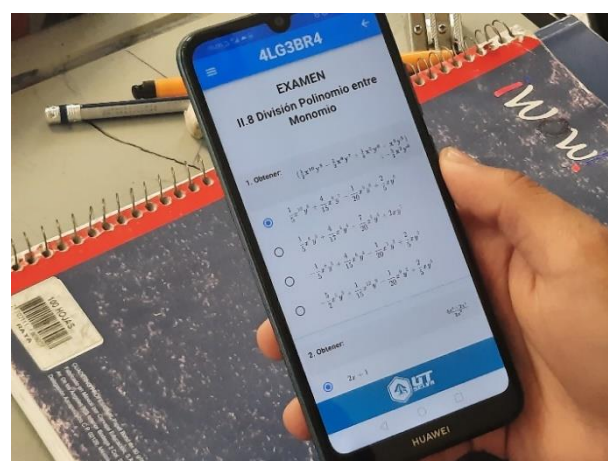
**Figure 2** Intervention with the 4LG3BR4 App with the experimental group  
*Source: Images from the research.*



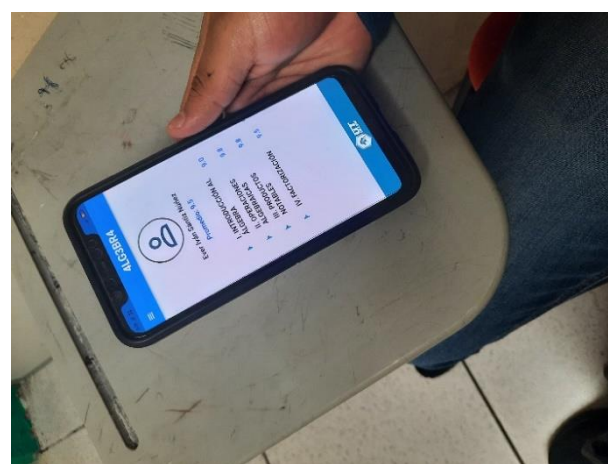
**Figure 3** Student reviewing the infographic containing concepts and examples.  
*Source: Images from the research.*



**Figure 4** Student reviewing the exercise videos.  
*Source: Images from the research*



**Figure 5** Student solving a test.  
*Source: Images from the research.*



**Figure 6** Student finishing the use of the 4LG3BR4 App.  
*Source: Images from the research.*

## Data collection phase

Once the intervention was completed, the post-test was applied to both groups to measure the academic performance acquired in the basic algebra topics.



## Results

To test the hypothesis of the research, the software RStudio Version 2022.07.1 was used, in which firstly, the normality test of the data was performed, obtaining a value of  $p < 0.001$  for both groups, indicating that the data are not normal; consequently, the Mann-Whitney U test for independent samples was used, obtaining a value of  $p=0.0012$  which is less than the significance level  $\alpha = 0.05$ , therefore, the null hypothesis is rejected, i.e., the data support that there is a significant difference between both groups, accepting the hypothesis of the research.

## Conclusions

The results obtained in the study show that using a tool such as the App 4LG3BR4 in the teaching and learning process, students obtain better results in their academic performance, compared to students who learn in a traditional way, therefore, to the teachers of the technological academic programs of this institution, the use of the App 4LG3BR4 is suggested as a didactic tool to support the teaching process in future generations; in addition, its use is recommended in other Institutions of Higher and Middle Higher Education.

## Open lines of research

The completion of this study leaves open some lines of research to explore, such as the use of the App 4LG3BR4 with high school students, in semesters that include mathematics subjects that include the topics of Algebra.

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