The learning of differential calculus mediated by the platform Khan-academy

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Abstract. Through the most recent years Information and Communication Technologies (ICT) have been positioned as powerful and revitalizing mechanisms in the educational processes. Therefore, this study measures the incidence of a digital platform by the learning of real functions with a view of identifying didactic strategies that contributes to the strengthening and development of mathematical knowledge in reference to the variational thought. The original random sample was primary conformed by students of second semester at a technological academic formation of an institution of higher education based on Santander- Colombia (N=176). The respective quantitative study is being considering by the correlation type, with the proper use of the Spearman’s correlation coefficient and descriptive statistics. The used program to realize this kind of analysis was the statistical software SPSS. So far at this point the results shows that the average academic performance on the partial of functions evidenced was 2.61 with standard deviation (SD)0.92, meanwhile in another way by the independent work that is being taken in the Khan-Academy’s platform scored 3.72 with a (SD) 0.2. Besides, it can be said that the bivariate correlation coefficient shown a substantial relation of 0.846 with a significance level of 1%. in all the process the conclusions that can be considered, it can be affirmed the strong relation between the study variables, denoting in fact that the correlation coefficient showed a clear association between the variables.

1. Introduction
In modern times the globalization has improve and increased with the application of Information and Communication Technologies (ICT) in so many fields of action, one of them that we can suggest is the educational sphere, through the implementation of brand new pedagogical methods that will let generate better results in the learning-teaching process [1]. So that manner, for example the massive use and promotion of (ICT) in the institutions of Higher Education has permeate and developed integration pathways in the complex formative process encouraging the strengthening of competences in different areas of study and promoting optimal learning outcomes [2].

Currently, education in Colombia is a constitutional right and it is the duty of the State to facilitate their access to the different educational levels with quality indexes. However, in national and international tests implemented for the measurement of skills, the rankings position Colombian students in the last places due to the low performance obtained in the different areas of knowledge [3] and [4]. Precisely, in the area of mathematics the results show the low level of competence development that Colombian students possess in solving simple problems that involves the daily life matters [5], contemplating this kind of harsh perspective, and making an exercise of identify potholes
and challenges the Ministry of National Education (MNE) faces a constant evaluation and commitment to improve of a great way the national education system.

Considering that the educational service offered by IES should, First, face the mathematical weaknesses within which the students enter at the first academic semester, second, contribute to the development of mathematical skills that facilitate and allow their graduates to perform optimally in the work environment, reviewing this Parameters the need to provide alternative solutions arises through (ICT) [6-7], for the promotion, strengthening and assurance of mathematical skills in higher education; that lead to the students enhance their own academic performance with innovative, didactic and flexible methods [8-9].

In fact, the Khan-Academy digital platform is an easily accessible tool, which promotes the development of online mathematical competences fostering self-learning at all educational levels [10]; through a wide compilation of virtual courses that contains video clips, exercises, clues and proper feedback, everything is defined in function to the prior knowledge of each student [11-12]. For this reason, the main purpose of the study emphasizes in evaluate, the relation and connection among the resultant qualifications obtained in the partial of the first academic section regarding the functions topic and the own independent work realized in the Khan-Academy platform, by students of technological level of a higher education institution.

2. Methodology
The methodological approach of the research was quantitative of correlation type, for it, one random sample formed by 176 students of second semester of an Institution of Higher Education in Santander-Colombia was taken, from the subject of differential calculus (first academic cut). The investigation was divided into the following phases:

2.1. First phase, implementation of the Khan-Academy platform
The students carried out 28 reinforcement activities concerning the subject of functions of real variable as independent work on the platform.

2.2. Second phase, written test of the functions topic
After the completion of the classes and the independent work on the platform the written test of the first cut was carried out around the topic of real variable functions.

2.3. Third phase, results analysis
We proceeded to make descriptive statistics and the Spearman’s correlation coefficient was implemented to measure the level of relation between the independent work on the Khan-Academy Platform and the academic performance obtained in the written test of functions topic in the statistical software SPSS. The variables were assessed on the scale of 0 to 5 point, with a minimum passing score of 3.0 (three point zero).

| Tabla 1. Descriptive statistics |
|----------------------------------|
| Khan Academy | Partial of Functions |
| Mean | 3.72 | 2.61 |
| Median | 4.00 | 2.45 |
| Mode | 4.00 | 2.00 |
| Standard deviation | 0.92 | 0.92 |
| Sample variance | 0.84 | 0.84 |
| Kurtosis | 1.12 | -0.22 |
| Asymmetry coefficient | -1.05 | 0.42 |
| Minimum | 0.90 | 1.00 |
| Maximum | 5.00 | 5.00 |
| Confidence level (95.0%) | 0.14 | 0.14 |
3. Results

According to the Descriptive measures observed in the Table 1 we can verify that there does exist a dispersion in the data. Meaning, that the Khan-academy’s distribution variable doesn’t follow a regular distribution as it can be appreciated in Figure 1, while for the partial variable of functions there is a slight asymmetry in the data, in a way that we could conclude that the data distribution is a normal asymmetrical distribution (see Figure 2).

![Figure 1. Histogram of performance in Khan Academy around to the functions topic.](image1)

![Figure 2. Histogram of performance on the partial of functions.](image2)

Analogously, Figure 3 describes the behavior of the study variables where it can be valuing the asymmetry in both distributions. Likewise, it is highlighted that the median of the Khan-Academy is greater in front of that performance on the partial of functions.

![Figure 3. Box-plot of performance on Khan-Academy and partial of functions.](image3)

To affirm the final results a normality test of Kolmogorov-Smirnov (KS) type was applied of the study variables (see Table 2), where we can observe that none of the variables has a $p$ value higher to the 5%, which leads us to reject the null hypothesis of normality (Equations 1 and 2).

| Table 2. Normality test of the study variables |
|-----------------------------------------------|
| Variable          | Kolmogorov- Smirnova |
|                  | Statistical | gl | P-Valor |
| Khan-Academy      | 0.247       | 176 | 0       |
| Functions midterm | 0.095       | 176 | 0.001   |

Correction of Significance of Lilliefors

$$H_0: \text{Normal distribution} \quad (1)$$
\[ H_1: \text{It doesn't have normal distribution} \] (2)

After the obtained results in the Kolmogorov’s proof we use the coefficient of bivariate correlations no parametric of Spearman in order to determine the level of association between the variables Khan-Academy y partial of functions. The Table 3 shows that there is an association of 0.864 among the independent work done in the Khan-Academy platform and the obtained results on the partial of functions.

| Tabla 3. Spearman’s correlation coefficient. | Khan-Academy | Functions |
|---------------------------------------------|--------------|-----------|
| **Correlations**                            | **Correlation coefficient** | **(Bilateral) Sig.** | **N** |
| Khan Academy                                | 1.000        | 864**     | 176    |
| Spearman’s Rho                              |              | 0.000     | 176    |
| Partial Of Functions                        | 864**        | 1.000     | 176    |
| **(Bilateral) Sig.**                        | 0.000        |           |       |
| **N**                                       | 176          | 176       |       |

**The correlation has a significance level of 0.01(bilateral).**

4. Conclusions

There is a direct and significant correlation between the two study variables, this is to say, the use of the Khan-Academy platform is related with the obtained results in the written test of the real functions topic. The research merits an upcoming study where it’s included the complete academic performance of the students who are pursuing the area of differential calculus and their relationship with the independent work done in the Khan-Academy platform. The use of inferential techniques and experimental study is implicitly required to ensure that the incorporation of ICT in the educational sphere be a support system for the teacher, that allows and projects a better performance on the part of the student in the differential calculus subject.

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