Chapter 3
Cybernetic Model by Blended Learning Using Technological Applications About Mathematics in Higher Education

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ABSTRACT

Traditional teaching has been changing with the development of information and communication technologies (ICTs). Blended learning is a new approach that enriches the education of students in order to improve their performance in their different subjects. Mathematics learning is a subject matter that is particularly difficult for students. The present chapter targets the application of a cybernetic model for blended learning in the teaching of mathematics, that is, the elements of communication and control are incorporated into this learning paradigm. It applies to first-year students of mathematics at the university level in the area of engineering. The results show an improvement in tests applied to students before and after the inclusion of activities with technological applications.

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INTRODUCTION

Since the 1960s, when assessment tests have been developed to establish a ranking of achievement by country and by educational institutions, scoring has become a factor that affects national educational policies and generates pressures to adopt the educational practices of those countries with the highest performance, but also, in the opposite case, in the countries with the lowest performance, the political perspective of education changes. One of the areas of greatest interest is school performance in mathematics, which is assessed globally on a large scale through two surveys: the International Trends in Mathematics and Science Study (TIMSS), which provides data on the mathematical performance of fourth and eighth graders in various countries (in Mexico it is equivalent to secondary) and is implemented every four years; and the International Programme for Student Assessment (PISA), which measures the knowledge and skills of 15-year-old students in reading, mathematics and science. The first evaluates what they know, while the second focuses on what they are able to do with their knowledge (Eurydice, 2011).

The member countries of the European Community have set as a target to reduce the percentage of 15-year-olds with low achievement in mathematics to less than 15% by 2020, according to the Council of Europe, low achievement in mathematics is considered to be students who do not reach level 2 in PISA (Eurydice, 2011). For the American continent, the indicators of achievement and dropout in the area of mathematics in these tests are worrying; for example, PISA reports presenting achievement results in OECD countries indicate that almost one in four Latin American students (23%) does not reach the basic level of proficiency (level 2) in mathematics, which means that students may from time to time perform routine procedures, such as arithmetic operations in situations where all instructions are given to them, but have problems identifying how a (simple) real-world situation can be represented mathematically (e.g., comparing the total distance between two alternative routes, or converting prices to a different currency).

At level 2 (421 to 482 points) students must interpret and recognize situations in contexts that require only direct inferences. They can extract relevant information from a single source and make use of a single type of representation. They can use algorithms, formulas, conventions or basic procedures. They are able to make literal interpretations of the results. The proportion of Mexican students who do not reach this level of competence remains at 23% and remained stable from 2003 to 2015 (PISA, 2015). This result is worrisome since they are the students who aspire to enter the higher level.

In terms of performance, international standardized tests, such as PISA, seek with mathematical assessment to determine whether students can reproduce what they have learned, but also examine how they can extrapolate what they have learned and apply that knowledge in unknown circumstances, both inside and outside the school; that is, whether they acquire mathematical competence. This approach reflects the fact that modern economies reward individuals not for what they know, but for what they can do with what they know (INEE, 2012).

According to the OECD, university education is considered to play an essential role in fostering knowledge and innovation, both of which are fundamental to sustaining economic growth. Several OECD governments have placed special emphasis on improving the quality of education in science, technology, engineering and mathematics, reflecting the importance of these disciplines in driving economic progress, supporting innovation and laying the foundation for true prosperity. In addition, advanced scientific skills and competencies such as critical thinking, problem solving and creativity are considered essential for success in the labour market, regardless of students' final occupation (OECD, 2017).